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# DIESEL ELECTRIC LOCOMOTIVE NOISE STUDY

PREPARED FOR TRANSPORTATION DEVELOPMENT CENTRE

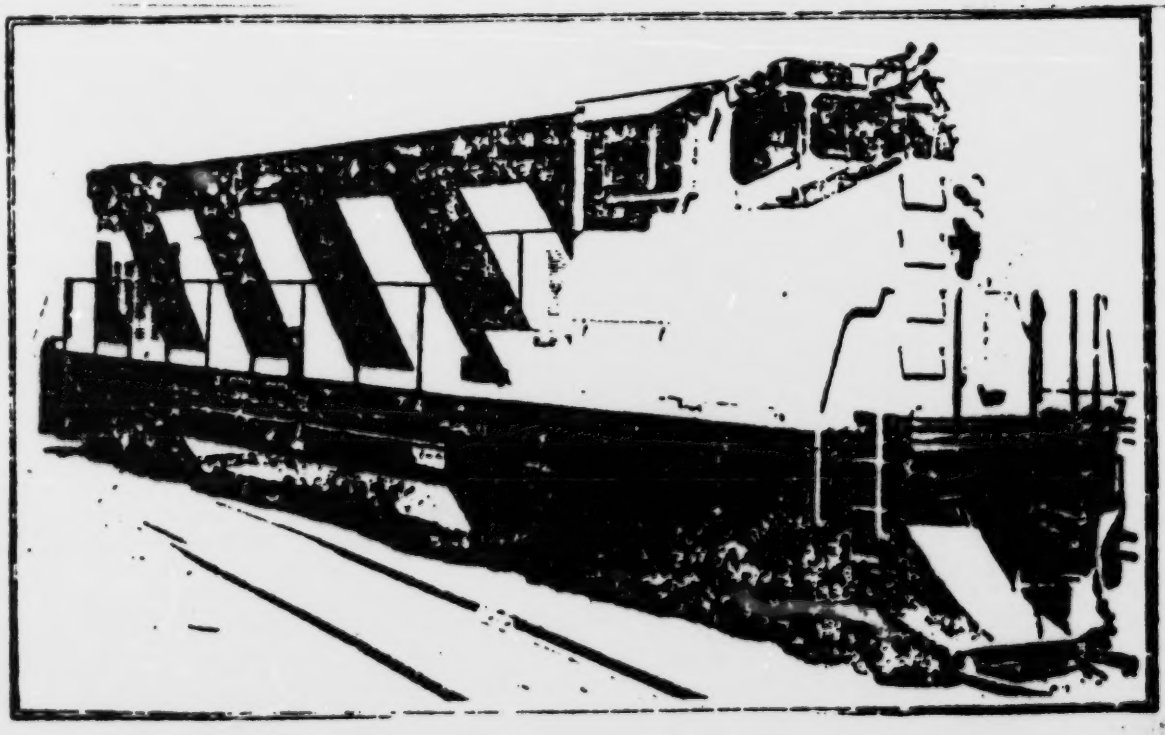
OF

TRANSPORT CANADA

BY

BOMBARDIER Inc.

RAIL & DIESEL PRODUCTS DIVISION



# DIESEL ELECTRIC LOCOMOTIVE

# NOISE STUDY

BY

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February 1981.

"The content of this report reflects the views of the contractor and not necessarily the official views or policies of the Transportation Development Centre of Transport Canada".

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17. Abstract

The following reports describes the results of a noise investigation performed on a 12 cylinder, 2000 H.P. mainline diesel-electric locomotive; in service with the Canadian National Railways. Both interior and exterior noise measurements were made on a standard M-420 locomotive. The stationary load box tests included cab interior noise, exterior wayside noise, and on-board equipment noise measurements. Maximum speed measurements included cab interior and 20, 50 and 100 ft. noise levels. Exterior noise levels were measured in accordance with E.P.A. Specifications.

The results show that significant improvement in noise levels, both inside and outside the locomotive, may be achieved by improving the sound isolation of the cab and installing an exhaust muffler.

This study was conducted during the period 1978-1981.

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17. Résumé

Le rapport qui suit donne les résultats d'une enquête sur le bruit, pratiquée sur la ligne principale d'une locomotive Diesel-électrique de 12 cylindres, 2000 h.p. présentement en service au Canadien National (C.N.R.). Les mesures du niveau de bruit furent prises à l'intérieur ainsi qu'à l'extérieur d'une locomotive standard M-420. Les essais stationnaires se sont effectués dans la cabine de contrôle, sur le bord de la voie ferrée (à l'extérieur) et près de l'appareillage se trouvant dans la locomotive. Pour les essais à vitesse maximum, les mesures ont été prises à l'intérieur de la cabine de contrôle, ainsi qu'à 20, 50 et 100 pieds de la locomotive. Les niveaux de bruit à l'extérieur furent mesurés selon les spécifications de l'E.P.A.

Les résultats démontrent que des améliorations significatives du niveau de bruit, à la fois à l'intérieur et à l'extérieur, peuvent être effectuées en améliorant l'isolation sonore de la cabine et en installant un silencieux.

Cette étude a été faite durant la période 1978-1981.

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## SUMMARY


This report presents a consolidated statement of a two year research and development program undertaken by Bombardier Inc. and Transport Canada -Transportation Development Center (T D C ); relating to the assessment of noise emission from a typical mainline locomotive existing in line haul service with a Canadian Railroad company.

The overall objective of this program was to improve the acceptability of railway diesel locomotive noise for both on-board operating personnel and those exposed externally.

The specific programme objectives were as follows:

1. To demonstrate the achievement of noise levels as set out below:

- In Cab:

| | | |
|---|---|---|
| (a) | At maximum locomotive speed | 76 dB(A) |
| (b) | Locomotive stationary in station | 76 dB(A) |
| (c) | Average of the following 1/3 octave bands at maximum rated locomotive speed (65 mph). (500 HZ, 1000 HZ, and 2000 HZ). | 79 dB(A) |

- Stationary Locomotive (at 50 ft. from track centre). line) load box tests.

| | | |
|---|---|---|
| (a) | Engine idling (overnight mode) | 66 dB(A) |
| (b) | Full hotel load (no traction) | 80 dB(A) |
| (c) | Engine at full load | 84 dB(A) |

- Locomotive passby measurements (at 100 ft. from track) center line)

| | | |
|---|---|---|
| (a) | Starting from rest | 85 dB(A) |

(b) At steady maximum rated speed (all systems operating, locomotive noise alone). 88 dB(A)

- To recommend realisable levels for the establishment of Locomotive Noise Control Legislation in Canada.

In order to achieve these objectives a phased program was conceived, which divided the program into three separate but related segments for investigation over a predetermined time frame and cost, as discussed in report No. EDS/P57 /470000[1] and EDS/P53/R & D.[2]. These segments included the following development stages:

(a) Measurement of the baseline noise signature of a M-420 locomotive in its standard configuration in accordance with the Environmental Protection Agency Railroad Noise Emission Standard.[3]

(b) Design and development of noise attenuation package to retrofit this locomotive without affecting its operating performance.

(c) Installing these packages and testing the locomotive in its quietened configuration.

The comprehensive test information obtained through this program has been used in the design of several other types of locomotives. It has been shown[4] that significant noise reduction was possible on those locomotives using some simple sound attenuation techniques without even modifying on-board equipment to improve its noise generation capabilities.

SUMMARY

(Cont'd.)

Following is a summary of the best numbers that were obtained on various Bombardier locomotives:

In Cab Noise:

| | |
|---|---|
| Loco. stationary - idling (overnight mode) | 64.5 dBA |
| Loco. " " (hotel load only) | 73.5 dBA |
| Loco. starting at full power (all systems operational) | 79.0 dBA |
| Loco. running at 50 MPH (engine at 1050 RPM) | 79.0 dBA |

External noise measured at 100 ft. from the locomotive:

| | |
|---|---|
| Loco. stationary - idling (overnight mode) | 61.5 dBA |
| Loco. " full load (load box test) | 85.0 dBA |

Pass-by noise measured at 100 ft. from the locomotive:

| | |
|---|---|
| Loco. starting at full power (all systems operational) | 85 dBA |
| Loco. running at 80 MPH steady speed (Notch 2) | 87.5 dBA |

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# 1.0 INTRODUCTION

In order to control noise pollution from railroad operations, a number of legislations have been introduced in the recent years, in order to put a limit to the locomotive noise emission levels. A majority of present day locomotives in line haul service with the railroads do not meet the current E.P.A. noise emission requirements. The purpose of this study was to measure noise emission from a typical mainline locomotive, identify and quantify the sources and demonstrate the feasibility of a noise retrofit package which, when installed, could help meet the criterion levels as set out in the statement of program objectives.

The present study was done in three stages, and the report deals with the first stage of the development program, viz. the study of baseline noise signature of a M420 locomotive.

A picture of this locomotive and a general layout of the on-board equipment are shown in figures 1 and 2, respectively.

The development program as originally contracted was not completed by Bombardier because of a prolonged strike, and because the experience gained on noise reduction on other Bombardier models has given Bombardier sufficient knowledge to meet any existing or proposed noise control legislation in North America.

## 2.0 - TEST PROGRAM

The test program was divided into two phases. The first phase involved static load box tests, which were carried out at MLW. The locomotive was parked in an open area and connected to a remote load box through long extension cables. The distance between the locomotive and the load box was approximately 400 ft, and was shielded with a sound barrier as shown in Fig. 3. Since this locomotive was not equipped with a (D.B.) dynamic brake, load box (standard M-420 D.B. unit) spectrum was measured at 3 ft. to give dynamic brake noise contribution. In order to control the radiator fan operation the normal thermostatic control switch was by-passed and a manual switch installed to switch 'on' and 'off' the fan, as desired. The air compressor was directly coupled to the engine and could not be switched off completely. For the purpose of noise tests, we could fill up the main reservoir to the rated pressure (140 psi) when the compressor would cut out and stop pumping, although the crankshaft keeps rotating. This was taken to the 'Compressor off' configuration. For 'Compressor On' test condition the by-pass valve could be opened to drop the reservoir pressure below the cutout pressure and the compressor would start pumping.

For the new near field source noise measurements, the background noise level was reduced as much as possible by switching off the sources not being monitored. The second phase involving the pass-by noise measurements was carried out in the Joliette sub-division of CNR. This was an open area with level tangent track. The test section was about 5 miles long. For acceleratio : tests (starting from rest), peak noise levels occurred when the locomotive had passed the microphone point. For the purpose of these tests, the locomotive was positioned such that the noise level peaked when the locomotive was in front of the microphone. For maximum speed tests, the desired

speed could not be obtained concurrently with maximum power condition, since the locomotive would keep accelerating. Therefore, a balance speed of 65 MPH was reached only by backing off the throttle to notch 6 on this test segment.

## 2.1 OPERATING CONDITIONS

Following are the operating conditions at which the reference noise data was obtained on the test locomotive:

Stationary Load box tests:

(i) Measured at 20, 50 and 100 ft. from the locomotive.

- (a) 400 rpm (Idle), no load, no auxiliaries*
- (b) Notch 1, rated load, no auxiliaries
- (c) Notch 2, rated load and auxiliaries
- (d) Notch 3, rated load and auxiliaries
- (e) Notch 4, rated load and auxiliaries
- (f) Notch 5, rated load and auxiliaries
- (g) Notch 6, rated load and auxiliaries
- (h) Notch 8, rated load and auxiliaries

* Auxiliaries include compressor and radiator fan.

(ii) Following source noise levels were measured at 3 ft. from the source when operating at the nominal speed and load (worst noise condition):

- (a) Exhaust noise level.
- (b) Radiator fan.
- (c) Dynamic brake
- (d) Primary air intake
- (e) Traction motor blower
- (f) Air compressor

## 2.0 TEST PROGRAM
(cont'd)

2.1 Operating conditions (cont'd)

(iii) Cab noise levels were measured under the following conditions:

(a) Idle, no load, no auxiliaries
(b) Notch 1, (400 rpm), rated load, no auxiliaries
(c) Notch 2, rated load and auxiliaries.
(d) Notch 3, rated load and auxiliaries.
(e) Notch 4, rated load and auxiliaries.
(f) Notch 5, rated load and auxiliaries
(g) Notch 6, rated load and auxiliaries
(h) Notch 7, rated load and auxiliaries
(i) Notch 8, rated load and auxiliaries

PASS-BY TESTS:

Interior and exterior noise measurements, when the locomotive was moving, were made under the following conditions:

(i) Starting from rest and accelerating past the microphone point in notch 8 with all auxiliaries in operation.

(ii) At maximum locomotive speed (uncoupled), full auxiliaries and rated load at this balance speed.

(iii) Cab noise measurements to be made at the maximum locomotive speed (uncoupled) on jointed track with full auxiliaries, while developing the rated tractive effort at this balance speed.

## 2.2 TEST PROCEDURE

All exterior noise measurements were made in accordance with U.S. E.P.A. Railroad Noise Emission Standards, as defined in the Federal Register part III issued January 14, 1976. This document[3] specifies the standard for locomotive operation, measuring instrument accuracy requirements, acoustical environment, weather conditions, background noise and microphone positions, etc.

All interior cab noise measurements were made in accordance with the MLW specification No. 849A 35192 - "General Procedures for Acoustic Measurements of In Cab Noise".

## 3 - INSTRUMENTATION

Following is a list of the instruments used for noise measurement and analysis during these tests:

(a) B & K impulse precision sound level meter, type 2209.
(b) B & K 1/3 octave filter set type 1616.
(c) B & K pistophone type 4220.
(d) Nagra SJ IV tape recorder (2-channel)
(e) B & K digital frequency analyser type 2131
(f) H.P. desk top computer type 9825 & 9845
(g) H.P. digital interactive plotter type 9872A.

All field measurements were made using the B & K impulse precision sound level meter calibrated at 250 Hz using a pistophone having an accuracy of calibration better than ±.2dB. The measuring system included a 1/3 octave filter set and Nagra SJ.IV 2-channel tape recorder. In all cases dB(A), dB (linear) and 1/3 octave measurements were made on site along with a 60 second signal trace on the magnetic tape for later analysis. The frequency response of Nagra SJ IV recorder is flat in the audio frequency range (20 Hz - 20 kHZ) and was checked by Nagra service engineers during the pre-test calibration. The recordings were made on SCOTCH 207 tape at 15 i.p.s. tape speed to give improved dynamic response. The combined frequency response of the recording system with this tape was checked in the laboratory at MLW using a signal generator and D.V.M. and was found to be flat within ±1.0 dB. in the range 50 to 10000 HZ, except at 350 HZ as shown in fig. 4. These corrections were applied to the signal at the analysis stage.

The 1/3 octave measurements recorded directly from the S.L.M. were plotted on

## 3.0 INSTRUMENTATION
(cont'd)

HP digital plotter interfaced to a pre-programmed desk-top computer type HP 9845T. The recorded spectra were analysed at the building acoustics laboratory at Concordia University, using a digital constant percentage band width type F.F.T.analyser, model B & K 2131. The output was plotted on the digital interactive plotter, model HP 9872B. The whole system was controlled by a HP desk-top calculator type 9825. The noise recording and analysis set-up is shown in fig. 5.

## 4.0 - RESULTS

### 4.1 SOURCE NOISE LEVELS

Source noise measurements were made at a distance of three feet from individual sources, in order to obtain their near field noise signature and an estimate of their relative strength. From previous studies[5-7] on the locomotive source noise levels, it was known that exhaust was the predominant source of noise, followed by the radiator fan. The contribution of these could be observed at 50 and 100 ft. microphone locations. The other sources, structural noise, compressor and engine casing radiated noise, were more significant close to the locomotive. In this study, the background noise level was reduced as far as possible while measuring a particular source, by shutting off the sources not being measured. Fan and compressor could be turned off during tests while dynamic brake blower was located remote from the locomotive. The other sources, particularly exhaust noise which could not be either muffled or shut off could however have smeared up the source noise spectrums.

Table 1 summarises the maximum source noise levels obtained on this locomotive near the individual sources.

The maximum overall A-weighed noise level from exhaust measured at 3 ft. from the stack was found to be 126.5 dBA. The background noise level at this microphone location was more than 25 dB below the measured levels across the frequency range, as shown in fig. 6. The exhaust noise spectrums at various notch settings and corresponding loads are shown in fig. 7. It was found that the noise spectrum was broad band with engine firing frequency (105 HZ) and its harmonics, as high as 20th, figuring prominently in the spectrum.

4.1 SOURCE NOISE LEVELS (cont'd)

Radiator fan noise levels were found to be 115.5 dBA inside the fan compartment and 106.5 dBA outside it at 3 ft. distance, as shown in Fig. 8 and 9-17 respectively. The spectrum peak at the blade passing frequency (128 HZ @ 1050 rpm) and rapidly drop off thereafter. After muffling the exhaust noise, fan noise would dominate the near field noise spectrum. A set of acoustic louvers (shown in fig. 18) has been designed to fit the existing radiator compartment to provide approximately 10 dB noise reduction at 3 ft. from the radiator compartment, without producing any appreciable head loss. The test results on these louvers are not yet available.

The maximum overall noise level from dynamic brake unit at 3 ft was found to be 111.5 dBA. The spectrum is shown in fig. 19. The main source of noise in dynamic brake was the blower that dissipates heat generated in the resistor grid. The ambient noise level during these measurements was 53 dBA. It is seen that the D.B. unit noise levels increase with load with no significant change in the spectrum.

Primary air intake noise, measured 3 ft. from the engine air intake filters at maximum rated rpm, was 105.5 dBA, as shown in fig. 20. It is seen that the exhaust noise harmonics figure prominently in this spectrum because of the proximity of the turbocharger to the intake filters.

4.1 SOURCE NOISE LEVELS (cont'd)

Traction motor blower noise level measured outside the auxiliary equipment compartment at notch 8 with fan and air compressor off was 96 dBA with doors closed and 105 dBA, doors open. The noise spectra at various other speeds are shown in fig. 21. It is seen that the blower noise increases with engine speed with no significant change in spectrum.

Turbocharger noise measured at 1 ft. from the turbo hatch outside the engine compartment was found to be 112.5 dBA while operating at the rated load and speed. The spectrum shown in fig. 22 is vary similar to the exhaust noise, as expected. It is flat from 200 Hz to 8 kHz. with the fundamental exhaust harmonic centered at 105 HZ band.

Air compressor noise at rated engine speed and measured 3 ft from the compressor compartment with doors closed, was 101.6 dBA. Fig. 23-31 show the compressor noise spectra at various speeds at the above microphone location. The compressor noise could not be distinguished from background noise when it was cut out. The spikes at low frequencies correspond to the compressor frequency which increases with engine speed.

Fig. 32 shows a comparison of source strength of various noise sources on this locomotive. It is obvious that significant noise reduction may be obtained by attenuating the exhaust and fan noise.

## 4.2 INTERIOR CAB NOISE MEASUREMENTS

4.2.1. Stationary Locomotive: Cab noise levels were measured at 3 different locations inside the cab, as shown in fig. 33, as per MLW specification[8]. The results showed that the sound field inside the cab is reverberant with no significant change from one location to another (maximum variation 1.2 dBA). Also some standing wave formation was observed at low frequencies. The main sources heard in the cab were the exhaust harmonics and auxiliary equipment. The measured results are shown in fig. 34 through 45, at various notch and load settings. It is observed (fig. 46) that the noise levels drop off approximately 6 dB/octave after 500 HZ. and nearly 10 dB/octave after 1k HZ. Below 500 HZ there is no definite trend. The significant difference in S.P.L. at 31.5 and 125 HZ bands may be attributed to the local reflections and standing wave activity at the designated microphone locations. The maximum overall level in the cab was between 84 and 84.5 dBA.

4.2.2. Locomotive moving at the maximum speed (65 mph):

The balance speed of 65 mph was obtained in notch 6 at the test track. Fig. 47 to 53 show the noise spectrum obtained at two microphone location in the cab. The max. noise level at the driver's seat was 82.9 dBA and 81.9 at the engineman's seat. The variation at each location was less than 2 dBA. Comparison of these levels with stationary cab noise levels at notch 6 showsthat there is insignificant increase due to the track noise contribution.

## 4.3 EXTERIOR NOISE MEASUREMENTS

4.3.1 Stationary Load box tests: These tests were carried out at the MLW test site with the locomotive in station and connected to a remote load box. All measurements were made on the right side of the loco (right side when standing in the cab and facing forward). The load box was located on the left side. Measurements made at 20 ft. with and without the turbo intake cone connection showed insignificant difference in S.P.L. Measurements made at 20, 50 and 100 ft. from the locomotive at different notch settings and corresponding load with auxiliary equipment in operation are shown in fig. 54 to 80. The locomotive noise is found to increase with load and speed. The propagation of sound follows nearly the free field law, i.e. approximately 6 dB drop per doubling of distance. The change in noise level from N-1 to N-8 at 20 ft. is 15.3 dBA, 18.9 dBA at 50 ft. and 21.7 dBA at 100 ft. Background noise level at 100 ft. (fig. 81) was 61 dBA. All measurements at this distance have been corrected for background noise interference. Examination of fig. 82 shows that the noise impact of auxiliaries at 100 ft. is marginal. Significant noise attenuation may be achieved by muffling the exhaust noise alone. Repeat noise measurements at 100 ft. at different throttle and load settings, with or without the auxiliary loads, are shown in fig. 83 & 84. Measurements made with hotel load only show a significant increase (approximately 8 dBA) in noise levels for a speed variation from N-7 to N-8, particularly in 8 kHZ band, where the turbo blade passing frequency exists. The overall increase in noise levels at 100 ft. from N-7 to N-8 at full load was however only about 2.2 dBA.

4.3 EXTERIOR NOISE MEASUREMENTS

4.3.1 Stationary load box tests (cont'd)

This indicates reduced variability in far field noise at rated loads for the same speed variation. Fig. 85 & 86 show the 50 ft. noise measurements with hotel load and with or without auxiliaries and load at various notch settings. The spectra have similar shapes at lower throttle positions. The main difference is at 8 KHZ. band where the levels increase in N-8 compared to approximately 9 dB/octave roll off at N-7. The overall maximum noise levels at 20, 50 & 100 ft. were found to be 96.8, 92.5 & 89 dBA respectively.

4.3.2 Pass-by noise measurements:

Pass-by noise measurements were made on right side of the locomotive at 20, 50 & 100 ft. from the locomotive when operating alone and passing by the microphone point at maximum rated speed (65 mph balance speed obtained in N-6) on a class 6 jointed track in Joliette sub-division of CNR. These are shown in fig. 87 to 91. Maximum pass-by noise levels measured at 20, 50 & 100 ft. were found to be 103.4, 97.3 and 93.8 dBA respectively. Maximum to run variation was found to be 2.7 dBA. Comparison of these levels with stationary noise levels show that there is a significant contribution from wheel-rail interaction to the wayside noise levels, particularly at close distance.

4.3.3 Pass-by tests - starting from rest:

These tests were made with the locomotive starting from rest in notch 8 from a point directly in front of the microphone.

4.3 EXTERIOR NOISE MEASUREMENTS

4.3.3. Pass-by tests - starting from rest: (cont'd)

Subsequent measurements made at 20, 50 & 100 ft. from the track centerline on right side of the locomotive are shown in fig. 94 to 100. The maximum overall levels at these distances were found to be 96.7, 91.4 and 87.6 dBA respectively.

4.4 DIRECTIVITY EFFECTS

In order to study the effect of the directivity on sound propagation around the locomotive, overall noise measurements were made at 20 ft. from the locomotive at the positions shown in fig. 101. It is seen that the sound field is fairly symmetrical around the locomotive longitudinal center line. Noise levels were higher on the back (fan side, 83 dBA) as compared to 70.5 dBA on the front (cab end).

## 5.0 - SUMMARY OF BASELINE NOISE TEST RESULTS

Fig. 102, 103 & 104 present a comparison of the baseline test results obtained on M420 locomotive against the proposed target levels for a quiet locomotive, under various operating conditions. It is shown in fig. 102 that we need to reduce the cab noise by about 15 dBA at N-8, with hotel load condition and 7 dBA at 65 mph speed. The locomotive already meets the proposed level at 0.5, 1 & 2 kHZ bands.

Fig. 103 shows that the exterior pass-by noise levels monitored at 100 ft. need to be reduced by about 6 dBA at 65 mph and 3 dBA at start-up conditions.

Stationary exterior noise levels at 50 ft. from the locomotive (shown in fig. 104) indicate a noise attenuation requirement of approximately 7 dBA in idle mode, 2.5 dBA in stand-by mode with hotel load and about 10 dBA in full speed, maximum load condition.

## 6.0 - APPLICATION OF M-420 TEST RESULTS TO THE NOISE RETROFIT OF OTHER BOMBARDIER MODELS.

The results obtained in this study were applied towards the design of noise attenuation packages to noise retrofit similar locomotives. The objective was to meet certain contract specifications. An examination of the exterior noise levels at 100 ft. indicated that a 10 dBA reduction in the exhaust noise at the source would help meet all those contract specifications for exterior noise levels.

Engine exhaust was found to be the most dominant source of noise. Two different silencer designs were developed to provide about 20 dBA noise attenuation at the source. In these designs, an attempt was made to keep the head loss to a minimum (total back pressure increase at the turbocharger outlet was less than 9 inch W.G.), while keeping its size small enough to fit into the available space envelope inside the engine hood. A silencer with rectangular cross-section and dissipative elements was designed with an expansion joint, as shown in fig. 105. The experimental evaluation of this silencer was performed on a MXS627 locomotive which was a 3000/2700 hp locomotive having a similar exhaust noise spectrum, with an overall exhaust noise level of 124.6 dBA. The measured insertion loss was 23.6 dBA at 3 ft. from the exhaust stack. Fig. 106 shows the unmuffled noise spectrum of M420 against MXS-627 and the muffled noise spectrum of MXS-627. The effect of this silencer on the 100 ft. noise levels was a reduction from 89 to 85 dBA. A similar reduction in noise levels was also shown on LRC tests. Introduction of this silencer on M420 is expected to bring about a 4 dBA reduction in noise. The resulting level is expected to be 84 dBA at 100 ft.

Besides the exterior noise levels at 100 ft, the other area where we often have had problems in meeting contractual specifications is the cab noise.

## 6.0 - APPLICATION OF M-420 TEST RESULTS TO THE NOISE RETROFIT OF OTHER BOMBARDIER MODELS. (cont'd.)

Data obtained from this study and others [4,9-12] have pointed towards the following facts:

- A significant portion of the sound energy in the cab is transmitted airborne.
- Major leakage paths exist between the cab and the auxiliary equipment compartment through the contactor compartment and doors.
- Exhaust noise harmonics figure prominently in the cab noise spectrum.
- Strong structural excitation exists at the engine and auxiliary equipment rotational speeds. Vibrating panels forming the cab outer structure need to be detuned or damped.
- Noise environment in the cab is reverberant. Sound absorption of the cabs need to be improved.
- Significant leakage paths exist to allow the track noise leaks through the floor and control stand openings into the cab. At high speeds this source is very significant.
- Motorised auxiliaries operating within the cab, e.g. wiper motor, air conditioning motor-fan, are significant.

Using these results and the common sound absorption/barrier materials, it has been shown in the above studies that significant cab noise attenuation (up to 8 dBA) may be obtained. Fig. 107 summarises the cab noise attenuation results obtained on various locomotives. To meet the objective criterion on M420 cab, we need only 5 dBA noise reduction, which we believe is attainable using a similar treatment on this locomotive.

## 7.0 - CONCLUSIONS

Results of the baseline noise tests on this locomotive show that, in its existing configuration, this locomotive does not meet the objective criterion levels. However, the insertion loss results obtained on the muffler, designed on the basis of this information, showed promising results. It is expected that it would be possible to meet the exterior noise level target by introducing this silencer with some modifications to the fan and radiator compartment. Significant acoustic leakage paths were noticed in the cab. By plugging these leaks and improving the sound absorption in the cab, together with improved sound transmission loss of the floor (which presently has no sound barrier or insulation), substantial improvement in cab noise levels may also be achieved.

Following is a summary of the best realisable levels that have been achieved on various Bombardier locomotives, and are well below all existing locomotive noise specifications.

Interior cab noise:

| | |
|---|---|
| Loco. stationary - idling (overnight mode) | 64.5 dBA |
| Loco. stationary - idling (hotel load only) | 73.5 dBA |
| Loco. starting at full power (all systems operational) | 79.0 dBA |
| Loco. running at 50 MPH (engine at 1050 RPM) | 79.0 dBA |

Exterior noise levels at 100 ft. from the locomotive:

| | |
|---|---|
| Loco. stationary - idling (overnight mode) | 61.5 dBA |
| Loco. stationary - full load (load box tests) | 85.0 dBA |

By-pass noise levels at 100 ft. from the locomotive:

| | |
|---|---|
| Loco. starting at full power (all systems operational) | 85 dBA |
| Loco. running at 80 MPH - steady speed (notch 2) with full train consist. | 87.5 dBA |

## REFERENCES


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2. "Cost proposal for the locomotive noise study - based upon the Transport Canada work statement", by D. Satsangi & M. L. Payne, MLW report No. EDS/P53/R & D.
3. "Federal Register: E.P.A. Railroad noise emission standards - Part III", issued Jan. 14, 1976.
4. "Noise control on LRC locomotive", D. Satsangi, D. D. Taylor, Bombardier Report No. 80-5-7001.
5. "Background document for railroad noise emission standards", N.T.I.S. publication No. PB 251713, report No. EPA/550/9-76-005.
6. "Background document environmental explanation for proposed interstate rail carrier noise emission regulations", June 74, E.P.A. office of noise abatement and control, report No. 550/9-74-005A.
7. "An assessment of railroad locomotive noise" by Paul J. Remington & M. J. Rudd, Aug. 76, Report No. D.O.T.-TSC-OST-76-4/FRA-OR & D- 76-142.
8. "General procedure for acoustic measurement of in-cab noise", by M. L. Payne, MLW Specification No. 849 A 35192.
9. "Noise Control on LRC locomotive", D. Satsanti & D. D. Taylor, Bombardier report No. TE 80-4-7001.
10. "Locomotive interior cab noise study", D. Satsangi & D.E.G. Crutcher, Bombardier report No. EDS-551-4736.

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11. "Tunisia locomotive in cab noise study", D. Satsangi & M. L. Payne, Bombardier report No. EDS-S39-4735.

12. "Investigation of cab noise on locomotives for Portuguese National Railways", D. Satsangi, D.E.G. Crutcher. Bombardier Report No. EDS/S51/4736.

APPENDIX I

LOCOMOTIVE DATA

GENERAL:

| | |
|---|---|
| Model No. | M 420 |
| Class AAR | B-B |
| Track gauge | 56.5 in. |
| Wheel diameter | 40 in. |
| Max. permissible speed (gearing 74/18) | 65 MPH |
| Min. continuous speed | 9.4 MPH |
| Traction motors | 4 |
| Air brake equipment | 26- LUM |

ENGINE DATA:

| | |
|---|---|
| Model | 251 |
| Traction horsepower | 2000 HP |
| Speed | 1050 RPM |
| Bore | 9 in. |
| Stroke | 10.5 in. |
| Cylinders | 12 |

CAPACITIES:

| | |
|---|---|
| Fuel oil | 2000 Imp. gals. |
| Lubricating oil | 216 " " |
| Cooling water | 260 " " |
| Sand | 56 Cu. ft. |
| Air compressor | 12.2 Imp. gals. |
| Generator gear case | 4 Imp. pts. |

APPENDIX I
LOCOMOTIVE DATA
(cont'd.)

CAPACITIES: (cont'd)

| | |
|---|---|
| Governor | 7 Imp. pts. |
| Traction motor bearing suspension | 4 Imp. qrts. ea. |
| Traction motor gear case | 16 lb. ea. |

NORMAL PRESSURE:

| | |
|---|---|
| Main air reservoir | 115-140 psi |
| Control air reservoir | 70 psi |

AUXILIARY EQUIPMENT SPEED AND HORSEPOWER RATINGS:

| Equipment | Speed | Max. horsepower |
|---|---|---|
| Air compressor | 1050 | 56 |
| Auxiliary generator | 2490 | 7 |
| Exciter | 2490 | 18 |
| Traction motor blower | 2490 | 51 |
| Bleed blower | 2490 | 7 |
| Engine room pressurizing fan | 2490 | 16 |
| Radiator fan | 1220 | 98 |
| Total auxiliary power | | 187 |

ENGINE OUTPUT:

| Notch setting | Engine Speed | Horsepower | K.W. |
|---|---|---|---|
| Idle | 400 | 0 | 0 |
| 1 | 400 | 121.6 | 90.7 |
| 2 | 493 | 227.7 | 170.0 |
| 3 | 586 | 382.4 | 285.3 |
| 4 | 679 | 594.9 | 443.8 |

APPENDIX I
LOCOMOTIVE DATA
(Cont'd.)

ENGINE OUTPUT: (cont'd)

| Notch setting | Engine Speed | Horsepower | K.W. |
|---|---|---|---|
| 5 | 772 | 874.4 | 652.3 |
| 6 | 856 | 1230.0 | 917.6 |
| 7 | 957 | 1665.6 | 1242.0 |
| 8 | 1050 | 2200.0 | 1641.2 |

APPENDIX II

SUMMARY OF TEST RESULTS FROM THE BASELINE NOISE MEASUREMENTS

1.0 EXTERIOR NOISE MEASUREMENTS:

Operating condition: Stationary locomotive connected to the load box and tested at various engine speeds and loads with auxiliaries at different distances.

(i) Mic.Posn. 20 ft. from the locomotive:

| Test condition | Measured S.P.L. in dB(A) |
|---|---|
| (a) Notch 8; F.L; F. Aux. | 96.8 |
| (b) Notch 7; Load, F. Aux. | 96.9 |
| (c) Notch 6; Load, F. Aux. | 95.1 |
| (d) Notch 5; Load, F. Aux. | 91.9 |
| (e) Notch 4; Load, F. Aux. | 88.5 |
| (f) Notch 3; Load, F. Aux. | 88.3 |
| (g) Notch 2; Load, F. Aux. | 83.4 |
| (h) Notch 1; Load, Fan off, aux. | 81.5 |
| (i) Idle, no load, no aux. | 78.3/77.5 |

(ii) Mic. Posn. 50 ft. from the locomotive:

| Test Condition | |
|---|---|
| (a) Notch 8; F.L, F. Aux. | 92.5 |
| (b) Notch 7; F.L, F. Aux. | 91.2 |
| (c) Notch 6, F.L. F. Aux. | 88.6 |
| (d) Notch 5; F.L, F, Aux. | 85.5 |
| (e) Notch 4; F.L, F. Aux. | 82.2 |
| (f) Notch 3; F.L, F. Aux. | 80.2 |
| (g) Notch 2; F.L, Fan off, aux. | 76.4 |

APPENDIX II

SUMMARY OF TEST RESULTS FROM THE BASELINE NOISE MEASUREMENTS
(cont'd)

1.0 EXTERIOR NOISE MEASUREMENTS:

(ii) Mic. Posn. 50 ft. from the loco. (cont'd)

| Operating Conditions | Measured S.P.L. in dB(A) |
|---|---|
| (h) Notch 1; F.L. Fan off, Aux. | 73.6 |
| (i) Idle | 70.8/72.4/71.4 |

(iii) Mic. Posn. 100 ft. from the locomotive

| Operating Conditions | |
|---|---|
| (a) Notch 8; F.L, F. Aux. | 89.0/87 |
| (b) Notch 7; F.L, F. Aux. | 85.0/84.8 |
| (c) Notch 6; F.L, F. Aux. | 83.8/83.5 |
| (d) Notch 5; F.L, F. Aux. | 80.3/78.6 |
| (e) Notch 4; F.L, F. Aux. | 76.4/76 |
| (f) Notch 3; F.L, F. Aux. | 74.9/73.5 |
| (g) Notch 2; F.L, Full aux. | 70.9/70 |
| (h) Notch 1; No fan; Aux. Load | 67.3/67.5 |
| (i) Idle, No aux. | 65.0/65.5 |
| (j) Background | 54. |

2.0 INTERIOR CAB NOISE

Locomotive Operating conditions:

Stationary loco. connected to the load box, tested at three different locations inside the cab at various loads and speed with auxiliaries and 2 persons in cab.

APPENDIX II

SUMMARY OF TEST RESULTS FROM THE BASELINE NOISE MEASUREMENTS

(Cont'd)

2.0 INTERIOR CAB NOISE

Locomotive Operating conditions: (cont'd)

| Test conditions | Mic. Location | Measured S.P.L. in dB(A) |
|---|---|---|
| Notch 8; F.L, F. Aux. | 2 | 84.5/84.9 |
| " " | 1 | 83.7/83.9 |
| Notch 7; F.L, F. Aux. | 2 | 84.0 |
| Notch 6; F.L, F. Aux. | 2 | 83.2 |
| Notch 5; F.L, F. Aux. | 2 | 80.8 |
| Notch 4; F.L, F. Aux. | 2 | 80.7 |
| Notch 3; F.L, F. Aux. | 2 | 79.0 |
| Notch 2; F.L, Fan on., aux. | 2 | 78.0 |
| Notch 1, F.L, Fan off, aux. | 2 | 75.9 |
| Idle | 2 | 73.7 |

3.0 INTERIOR CAB NOISE AT MAX. LOCOMOTIVE SPEED (65 MPH):

Operating condition: Locomotive running at steady speed of 65 MPH in notch 6 on class 6 jointed track with windows closed and 5 people in the cab.

| Microphone location | Measured S.P.L. in dB(A) |
|---|---|
| 1 | 80.1/81.5 |
| 2 | 78.5/81.9 |
| 3 | 82.4/82.9/82.8 |

APPENDIX II

SUMMARY OF TEST RESULTS FROM THE BASELINE NOISE MEASUREMENTS

(Cont'd.)

4.0 PASS-BY NOISE MEASUREMENTS:

Operating condition: Locomotive starting from rest with full throttle and all motorised auxiliaries in operation.

| Microphone Location | | Measured S.P.L. in dB(A) |
|---|---|---|
| 20 ft. | loco. starting from a posn. in front of the microphone | 92.9/93.4 |
| 20 ft. | loco. starting from a point 50 ft. before the microphone point. | 95.7/95.6/96.7 |
| 50 ft. | - do - | 90.1/90.3/91.4 |
| 100 ft. | - do - | 85.8/87.6 |

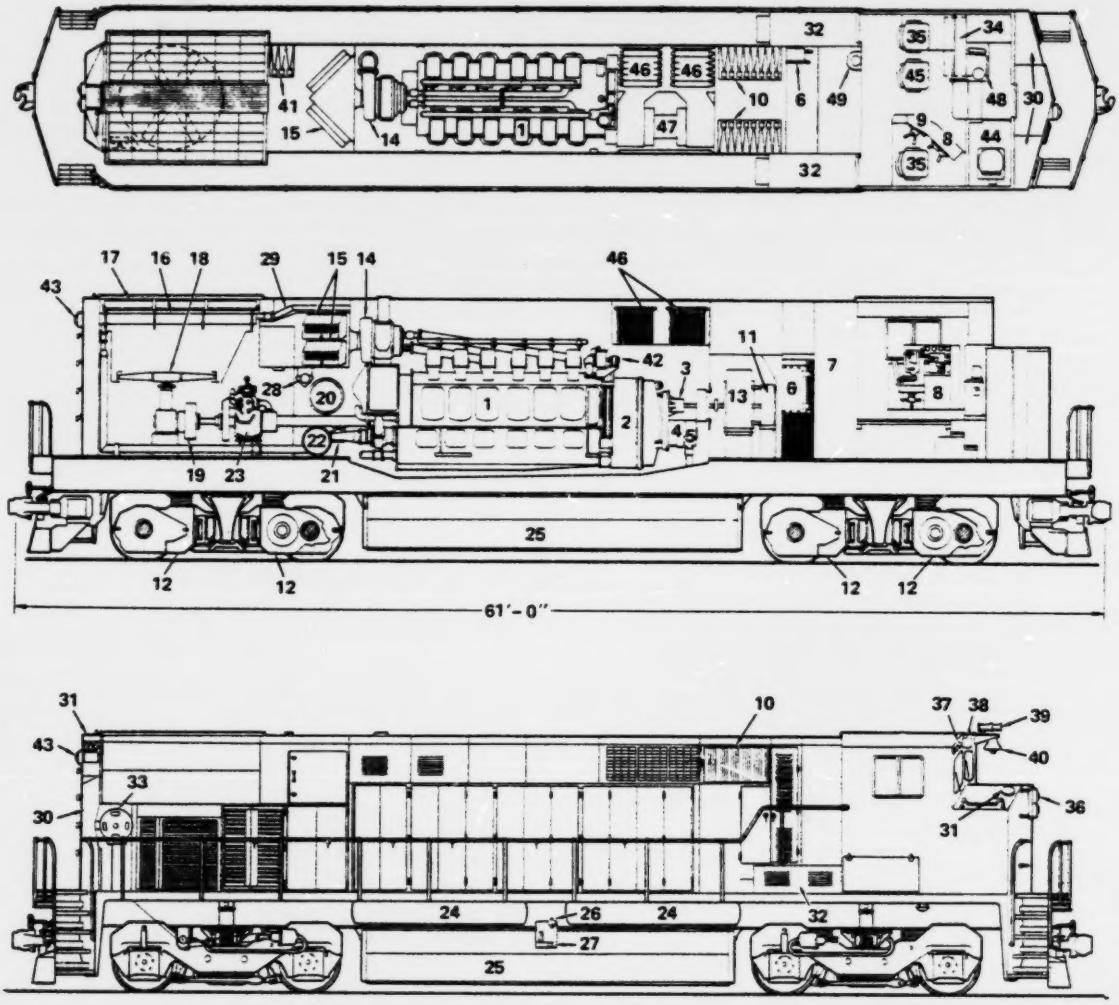
5.0 PASS-BY NOISE LEVELS AT MAXIMUM SPEED:

Operating condition: Single locomotive going past the microphone at 65 mph in notch 6, on AAR Class 6, jointed track.

| Microphone Location | Measured S.P.L. in dB(A) |
|---|---|
| 20 ft. | 103.4 |
| 50 ft. | 97.3 |
| 100 ft. | 91.8/93.8 |

M-420 DIESEL ELECTRIC LOCOMOTIVE

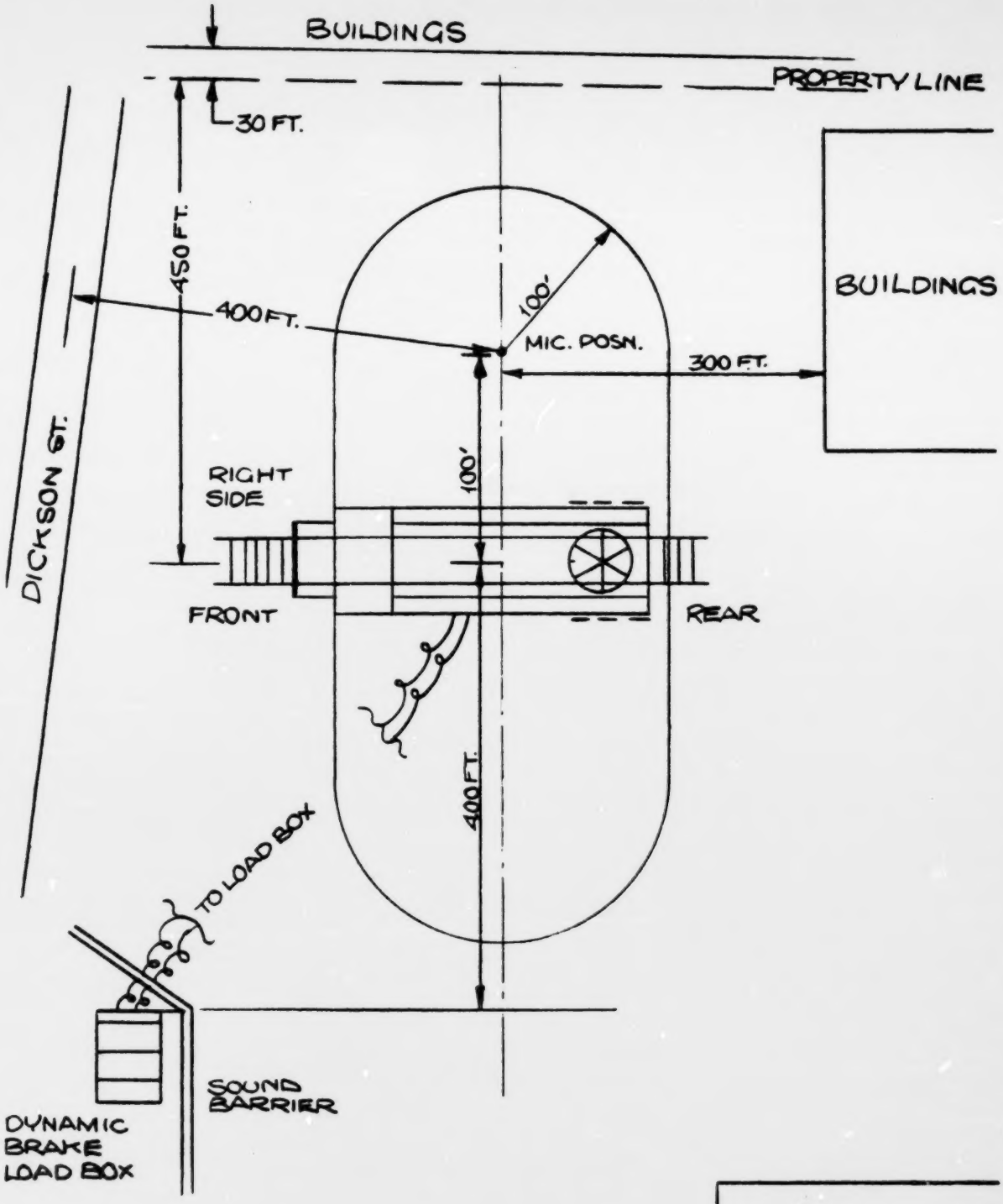
FIG. 1




1. Engine
2. Main alternator
3. Gear unit - blower drive
4. Auxiliary generator
5. Exciter
6. Rectifiers
7. Control compartment
8. Control stand
9. Brake stand
10. Mechanical air cleaner
11. Air cleaner exhauster
12. Traction motor
13. Blower - traction motor and generator
14. Turbocharger
15. Engine air intake filters - secondary
16. Radiator
17. Radiator shutter
18. Radiator fan
19. Radiator fan clutch
20. Lubricating oil filter
21. Lubricating oil strainer
22. Lubricating oil cooler
23. Air compressor
24. Main air reservoir
25. Fuel tank
26. Fuel tank filling connection
27. Fuel tank gauge
28. Fuel oil filter
29. Engine water expansion tank
30. Sand box
31. Sand box fill
32. Batteries
33. Hand brake
34. Cab heater
35. Cab seat
36. Headlight
37. Classification light
38. Number box
39. Horn
40. Bell
41. Engine air intake filters - primary
42. Crankcase exhauster motor
43. Back-up light
44. Toilet
45. Cab seat
*46. Dynamic brake resistors
47. Dynamic brake blower
48. Refrigerator
49. Hot plate

* Not Equipped

**FIGURE 2**
**MODEL M-420 DIESEL ELECTRIC**
**LOCOMOTIVE GENERAL ARRANGEMENT**




LAY OUT OF THE TEST SITE

FIG. 3

# NAGRA SJ-IV FREQUENCY RESPONSE CURVE WITH"SCOTCH-207"TAPE; AT 15 I.P.S.TAPE SPEED

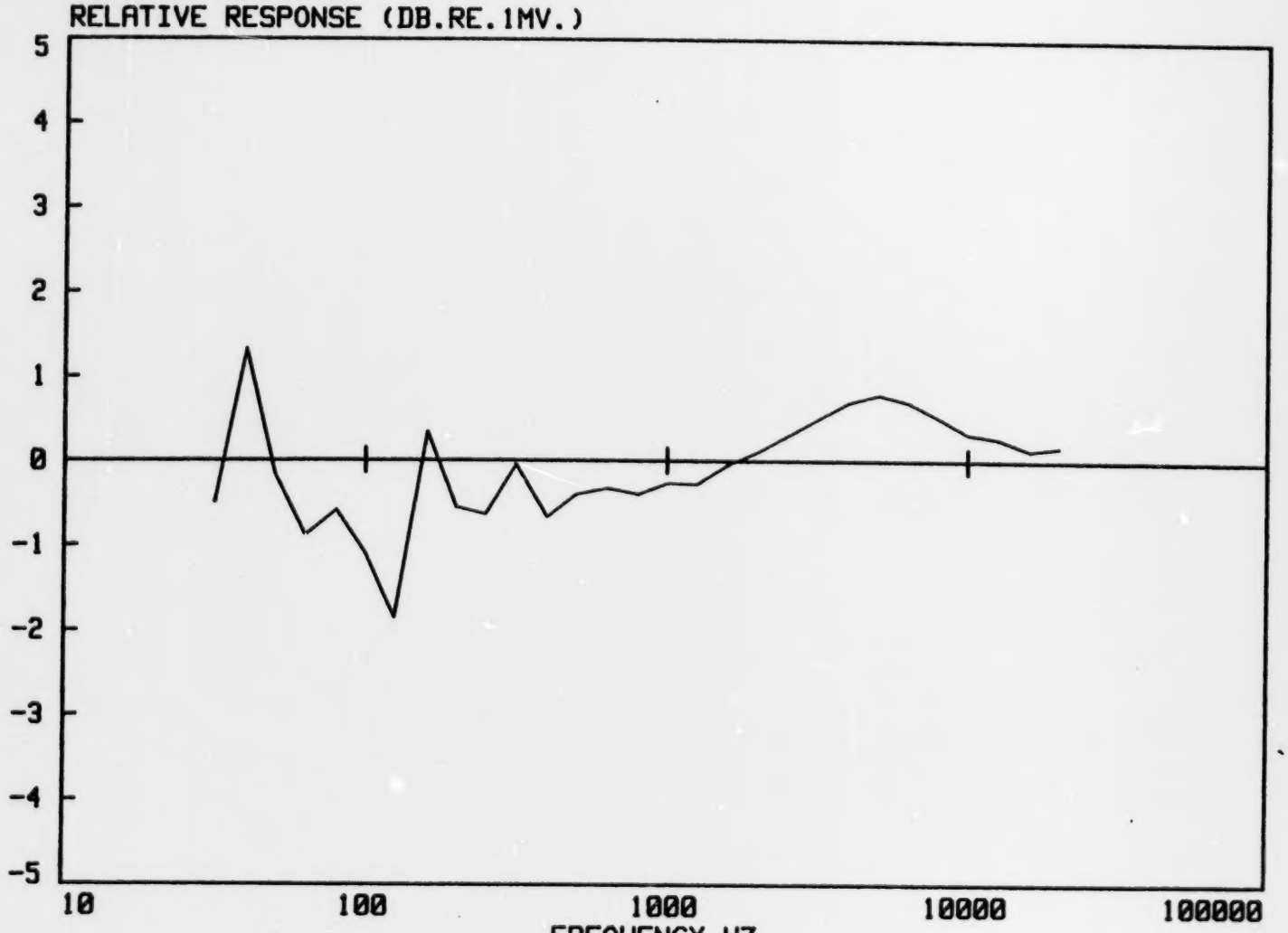
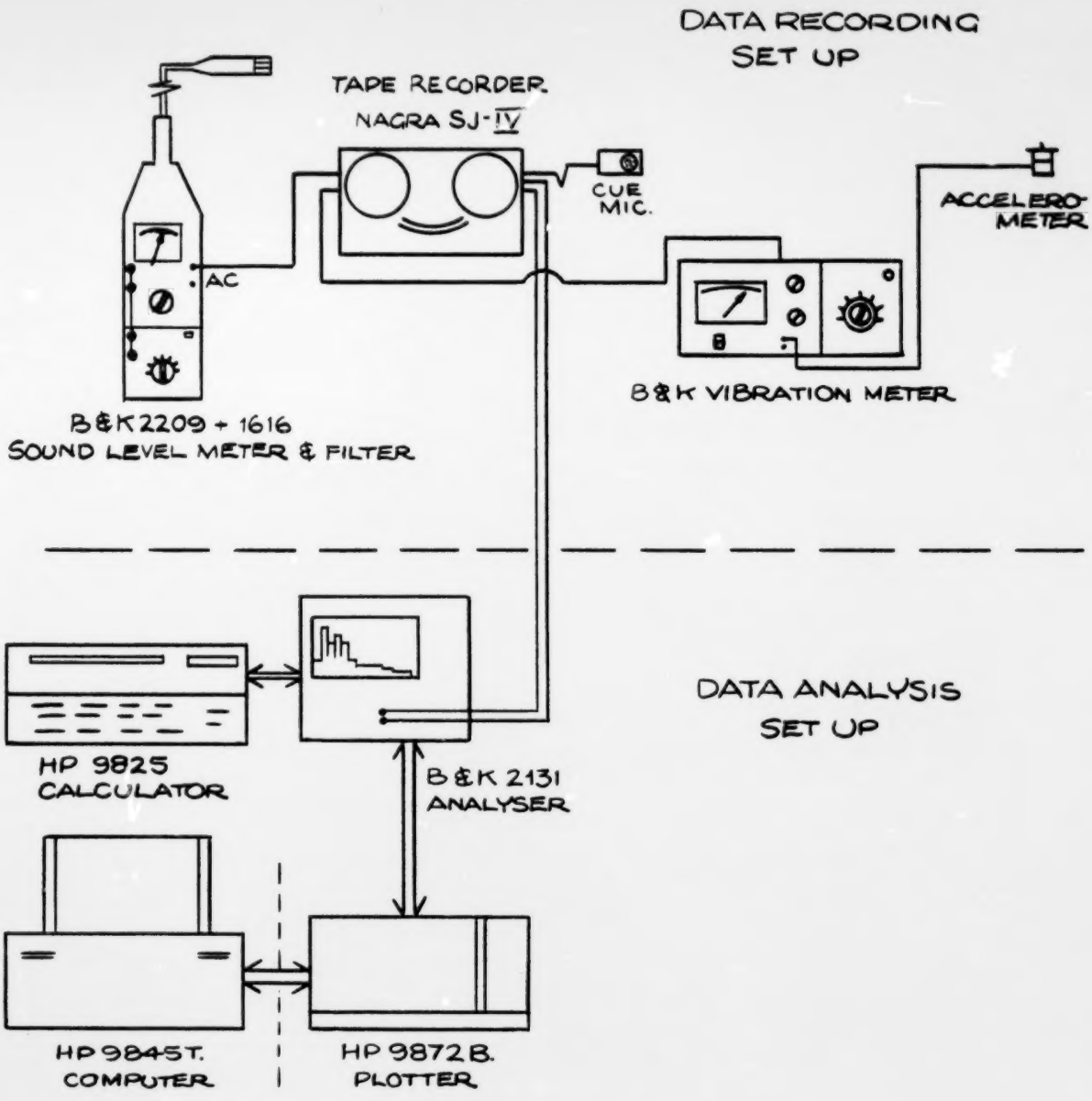



FIG. 4




INSTRUMENTATION SETUP FOR DATA RECORDING AND ANALYSIS

FIG. 5

# EXHAUST NOISE SPECTRUM AT IDLE & BACKGROUND NOISE(MEASURED 3FT.FROM EX.STACK @ 45 DEG.)

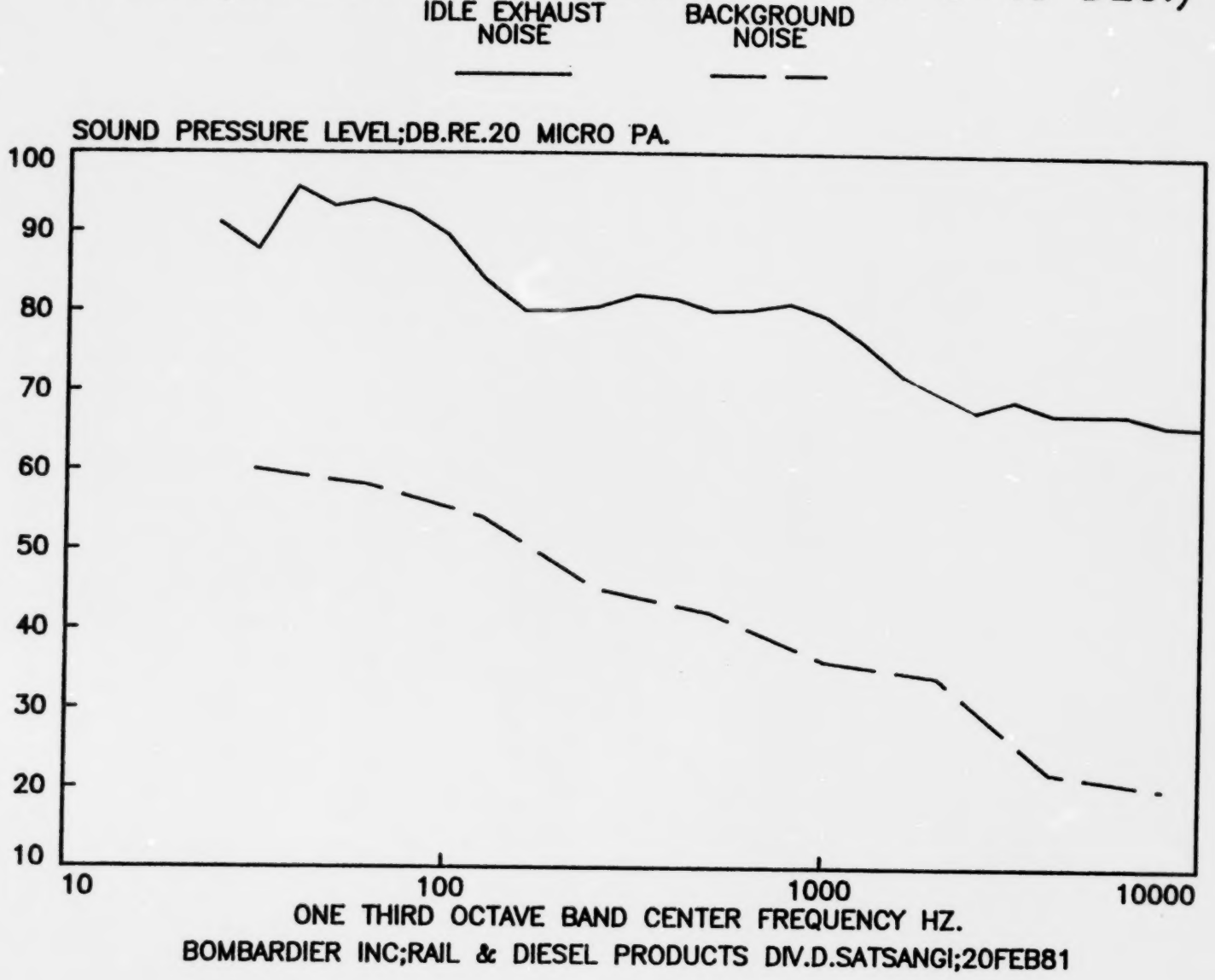



FIG. 6

# LOCOMOTIVE EXHAUST NOISE
# (MEASURED @3FT FROM EXHAUST STACK AT 45 DEG.)

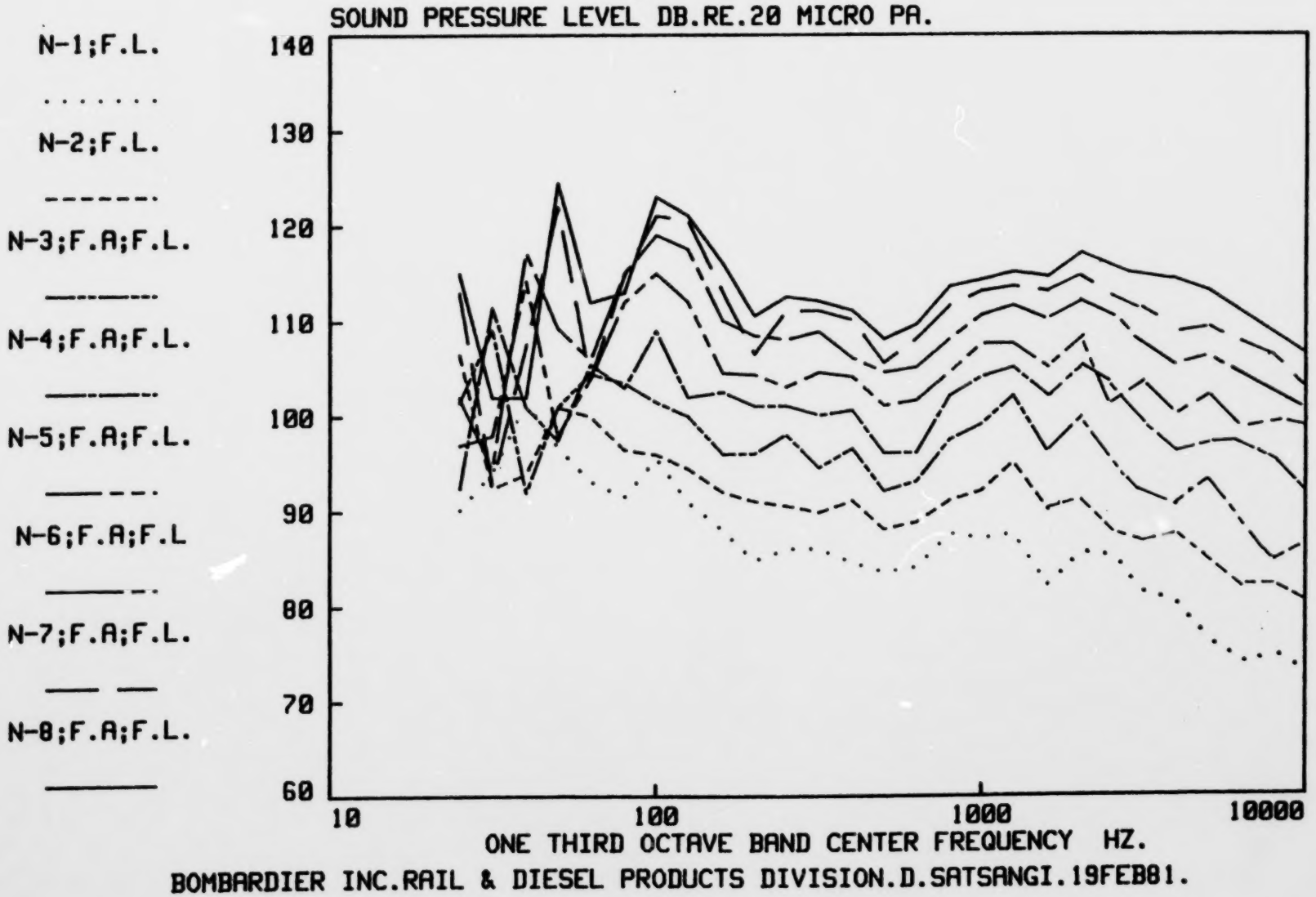



FIG. 7

# FAN NOISE SIGNATURE(MEASURED 1FT FROM THE LOUVERS INSIDE FAN COMPARTMENT )

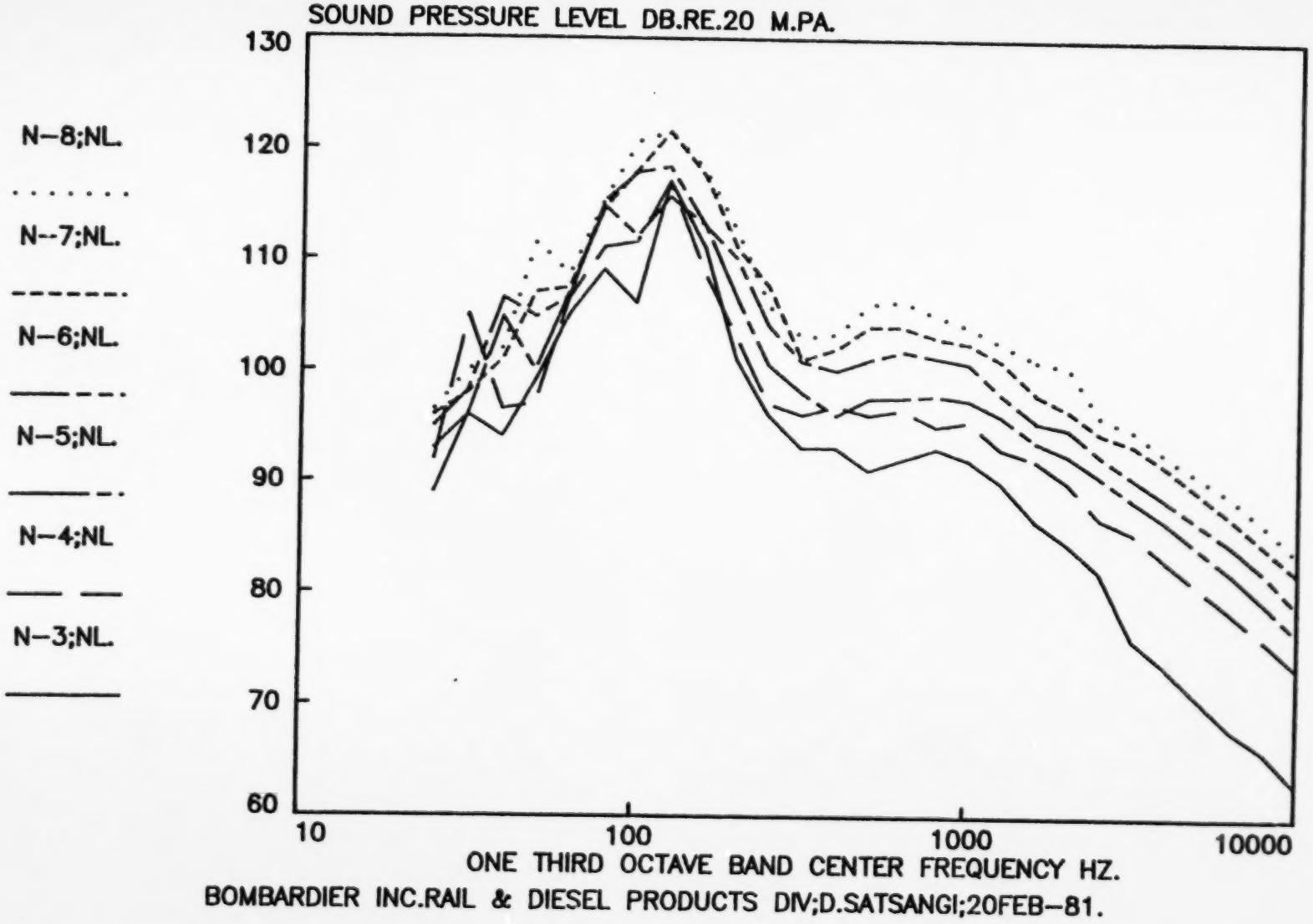



FIG. 8

# M420 FAN NOISE SIGNATURE(MEASURED 3FT.FROM LOUVERS AT DIFFERENT NOTCH SETTINGS.)

N-3 N-5 N-8

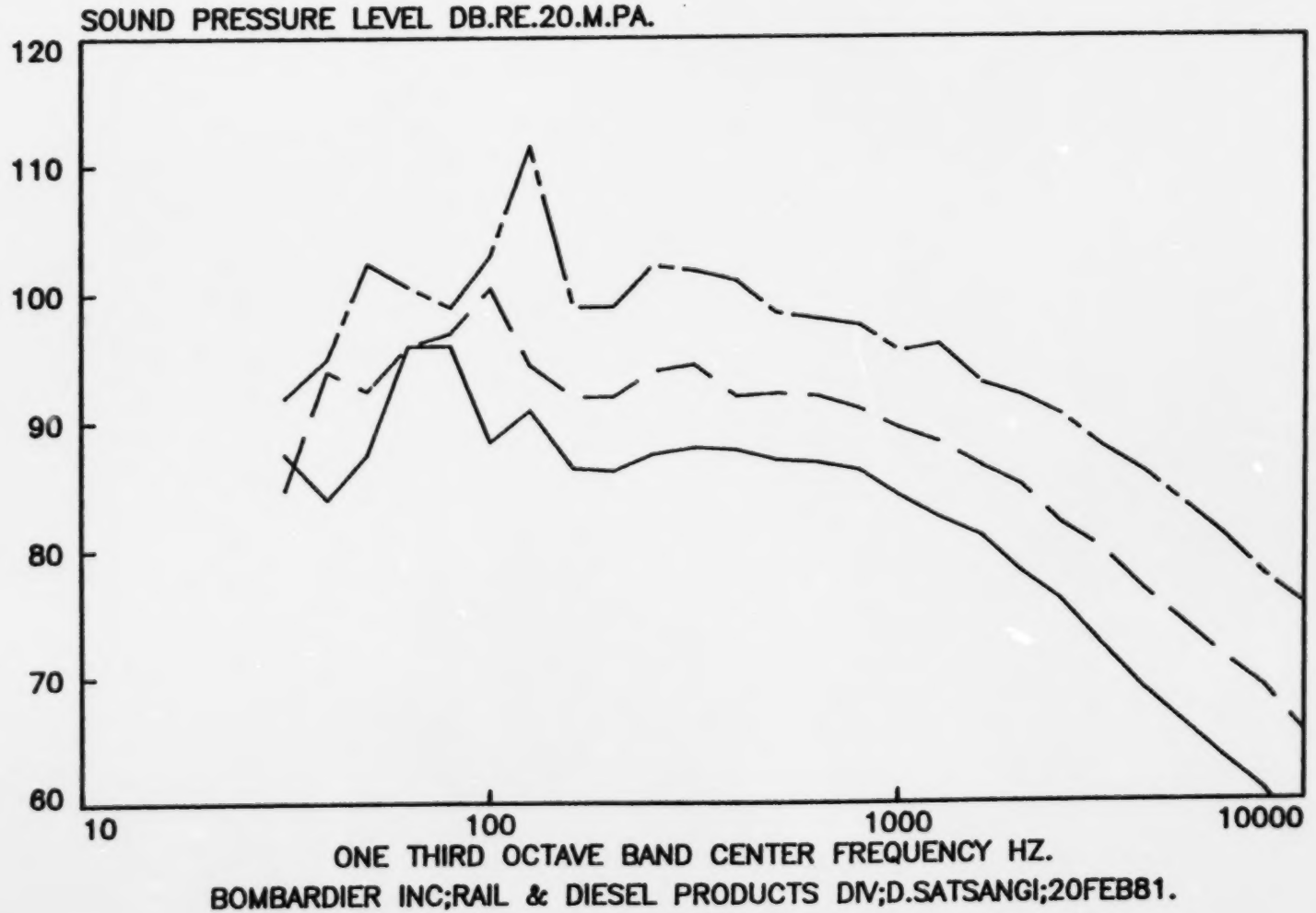
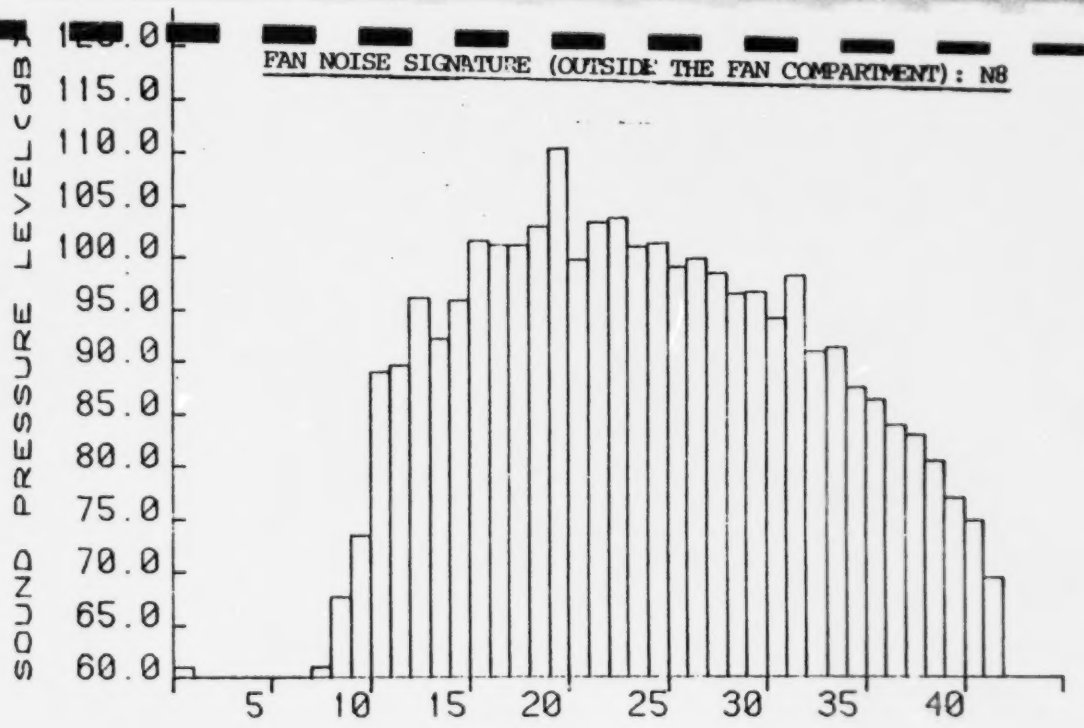



FIG. 9

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 61.0 |
| 2 | 2.0 | 60.0 |
| 3 | 2.5 | 60.0 |
| 4 | 3.2 | 60.0 |
| 5 | 4.0 | 60.0 |
| 6 | 5.0 | 60.0 |
| 7 | 6.3 | 60.0 |
| 8 | 8.0 | 61.0 |
| 9 | 10.0 | 67.6 |
| 10 | 12.5 | 73.4 |
| 11 | 16.0 | 89.0 |
| 12 | 20.0 | 89.7 |
| 13 | 25.0 | 96.1 |
| 14 | 31.5 | 92.2 |
| 15 | 40.0 | 95.9 |
| 16 | 50.0 | 101.7 |
| 17 | 63.0 | 101.2 |
| 18 | 80.0 | 101.2 |
| 19 | 100.0 | 103.0 |
| 20 | 125.0 | 110.3 |
| 21 | 160.0 | 99.8 |
| 22 | 200.0 | 103.5 |
| 23 | 250.0 | 103.9 |
| 24 | 315.0 | 101.1 |
| 25 | 400.0 | 101.4 |
| 26 | 500.0 | 99.1 |
| 27 | 630.0 | 99.9 |
| 28 | 800.0 | 98.5 |
| 29 | 1000.0 | 96.6 |
| 30 | 1250.0 | 96.6 |
| 31 | 1600.0 | 94.2 |
| 32 | 2000.0 | 98.3 |
| 33 | 2500.0 | 90.9 |
| 34 | 3150.0 | 91.4 |
| 35 | 4000.0 | 87.6 |
| 36 | 5000.0 | 86.4 |
| 37 | 6300.0 | 84.0 |
| 38 | 8000.0 | 83.0 |
| 39 | 10000.0 | 80.5 |
| 40 | 12500.0 | 77.1 |
| 41 | 16000.0 | 74.8 |
| 42 | 20000.0 | 69.3 |

A WEIGHTED LEVEL 107.7dB




Tape#9;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N8 ;Compressor Off

Fan Full;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3Ft/Fan

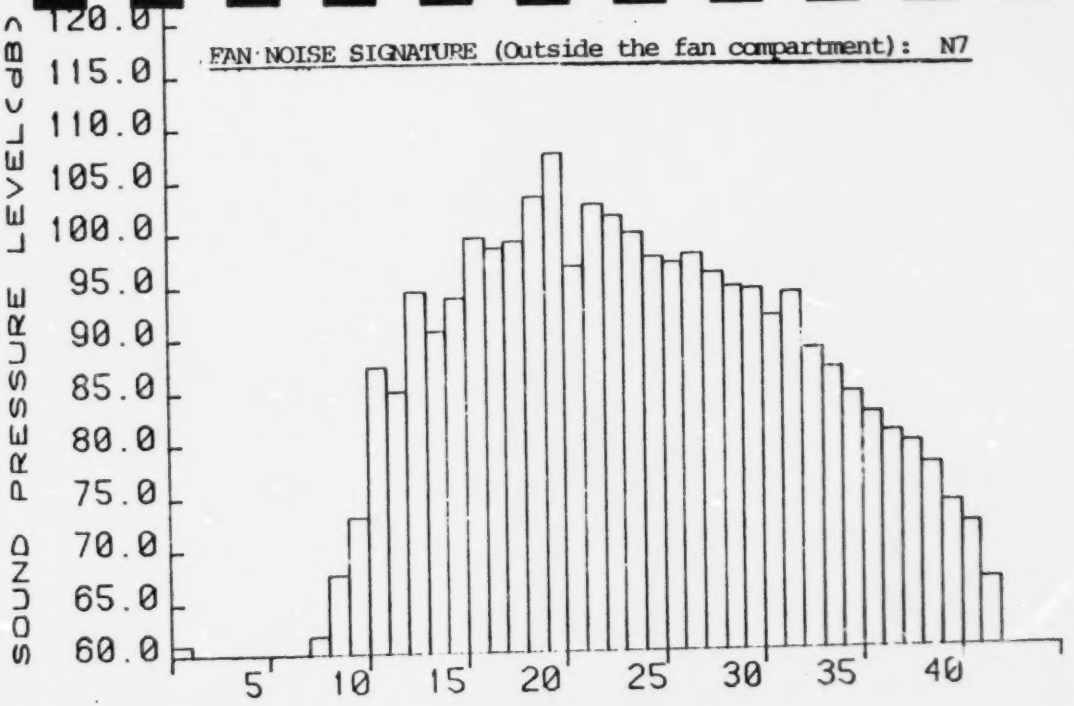
Att:2209=110,Nagra=40

Wind=400gt500 fpm from N.

FIG. 10

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 61.0 |
| 2 | 2.0 | 60.0 |
| 3 | 2.5 | 60.0 |
| 4 | 3.2 | 60.0 |
| 5 | 4.0 | 60.0 |
| 6 | 5.0 | 60.0 |
| 7 | 6.3 | 60.0 |
| 8 | 8.0 | 61.8 |
| 9 | 10.0 | 67.6 |
| 10 | 12.5 | 73.0 |
| 11 | 16.0 | 87.3 |
| 12 | 20.0 | 85.0 |
| 13 | 25.0 | 94.5 |
| 14 | 31.5 | 90.7 |
| 15 | 40.0 | 93.8 |
| 16 | 50.0 | 99.6 |
| 17 | 63.0 | 98.5 |
| 18 | 80.0 | 99.2 |
| 19 | 100.0 | 103.3 |
| 20 | 125.0 | 107.5 |
| 21 | 160.0 | 96.6 |
| 22 | 200.0 | 102.5 |
| 23 | 250.0 | 101.5 |
| 24 | 315.0 | 99.8 |
| 25 | 400.0 | 97.4 |
| 26 | 500.0 | 96.9 |
| 27 | 630.0 | 97.7 |
| 28 | 800.0 | 95.9 |
| 29 | 1000.0 | 94.6 |
| 30 | 1250.0 | 94.3 |
| 31 | 1600.0 | 91.8 |
| 32 | 2000.0 | 94.0 |
| 33 | 2500.0 | 88.6 |
| 34 | 3150.0 | 86.8 |
| 35 | 4000.0 | 84.5 |
| 36 | 5000.0 | 82.6 |
| 37 | 6300.0 | 80.7 |
| 38 | 8000.0 | 79.7 |
| 39 | 10000.0 | 77.5 |
| 40 | 12500.0 | 74.0 |
| 41 | 16000.0 | 71.8 |
| 42 | 20000.0 | 66.5 |

A WEIGHTED LEVEL 105.1dB




Tape#9;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N7 ;Compressor Off

Fan Full;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3 Ft/Fan

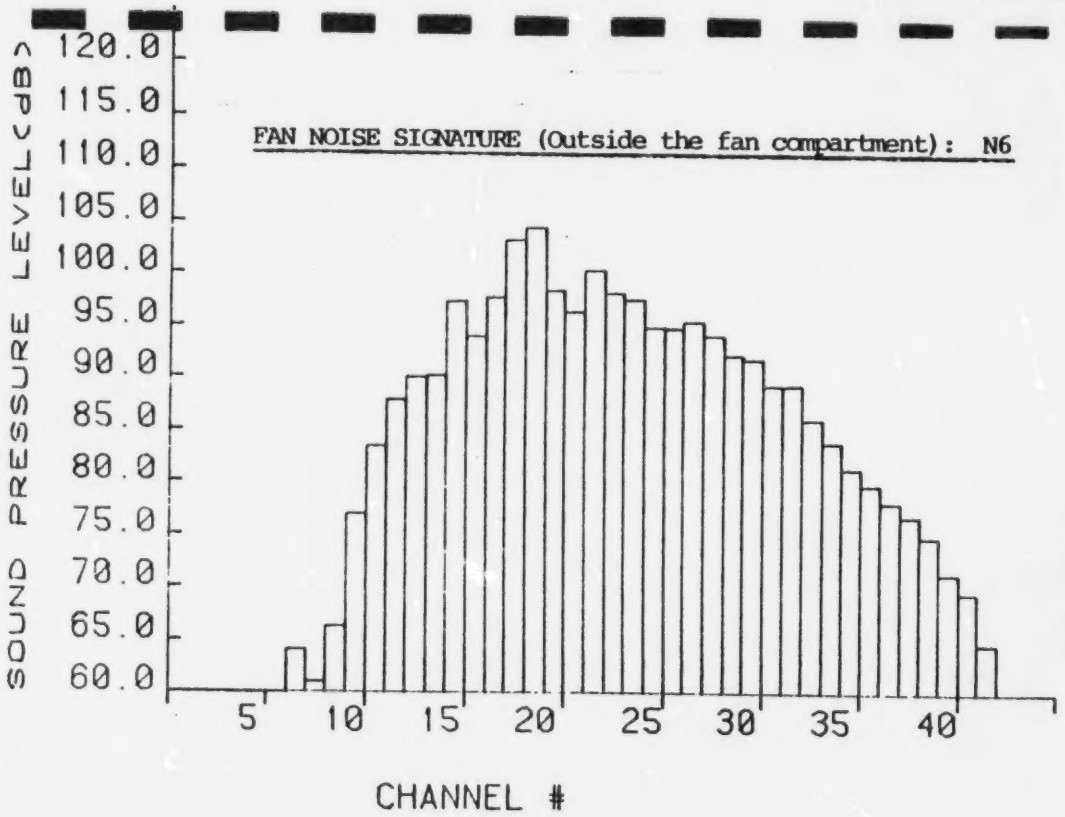
Att:2209=110,Nagra=40

Wind=400gt500 fpm from N.

FIG. 11

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 60.0 |
| 2 | 2.0 | 60.0 |
| 3 | 2.5 | 60.0 |
| 4 | 3.2 | 60.0 |
| 5 | 4.0 | 60.0 |
| 6 | 5.0 | 60.0 |
| 7 | 6.3 | 64.0 |
| 8 | 8.0 | 61.0 |
| 9 | 10.0 | 66.2 |
| 10 | 12.5 | 76.9 |
| 11 | 16.0 | 83.5 |
| 12 | 20.0 | 87.8 |
| 13 | 25.0 | 90.0 |
| 14 | 31.5 | 90.2 |
| 15 | 40.0 | 97.3 |
| 16 | 50.0 | 94.0 |
| 17 | 63.0 | 97.7 |
| 18 | 80.0 | 103.2 |
| 19 | 100.0 | 104.3 |
| 20 | 125.0 | 98.3 |
| 21 | 160.0 | 96.3 |
| 22 | 200.0 | 100.4 |
| 23 | 250.0 | 98.1 |
| 24 | 315.0 | 97.5 |
| 25 | 400.0 | 94.9 |
| 26 | 500.0 | 94.7 |
| 27 | 630.0 | 95.4 |
| 28 | 800.0 | 94.0 |
| 29 | 1000.0 | 92.2 |
| 30 | 1250.0 | 91.7 |
| 31 | 1600.0 | 89.3 |
| 32 | 2000.0 | 89.3 |
| 33 | 2500.0 | 86.0 |
| 34 | 3150.0 | 83.9 |
| 35 | 4000.0 | 81.4 |
| 36 | 5000.0 | 79.8 |
| 37 | 6300.0 | 78.1 |
| 38 | 8000.0 | 76.8 |
| 39 | 10000.0 | 74.8 |
| 40 | 12500.0 | 71.4 |
| 41 | 16000.0 | 69.5 |
| 42 | 20000.0 | 64.7 |

A WEIGHTED LEVEL 102.4dB




Tape#9;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N6 ;Compressor Off

Fan Full;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3Ft/Fan

Att:2209=110,Nagra=40

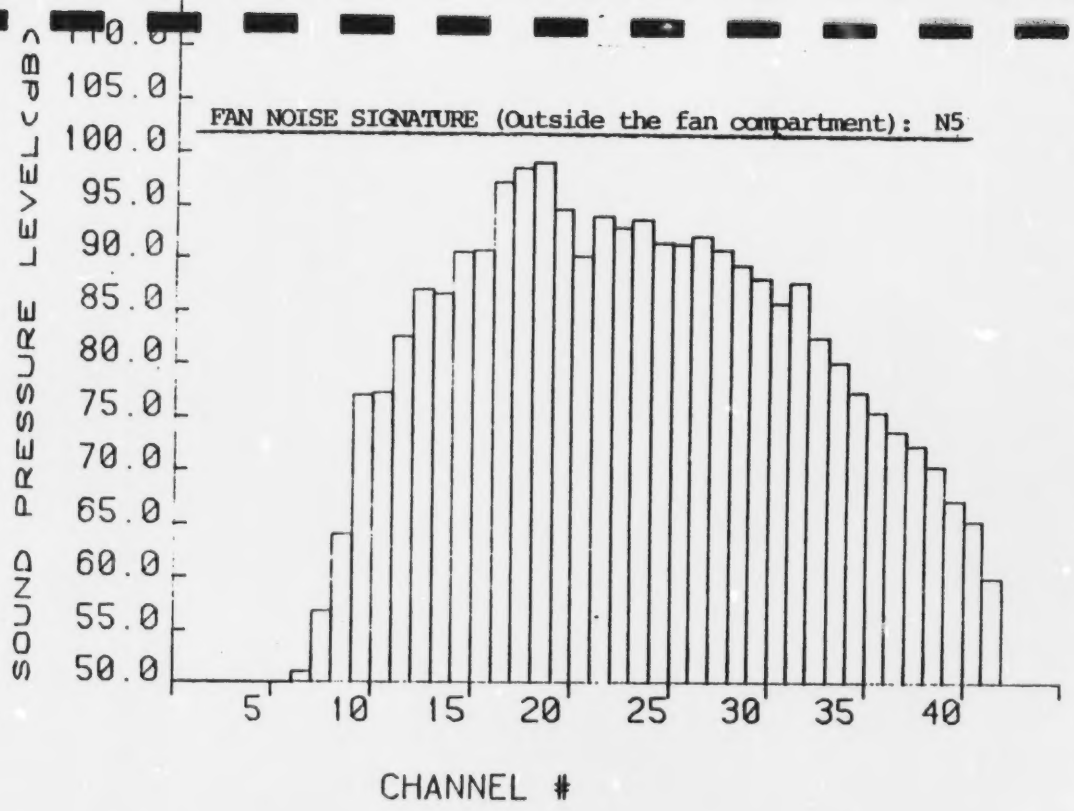
Wind=400gt500 fpm from N.



FIG. 12

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 51.0 |
| 8 | 8.0 | 56.7 |
| 9 | 10.0 | 64.1 |
| 10 | 12.5 | 77.0 |
| 11 | 16.0 | 77.3 |
| 12 | 20.0 | 82.6 |
| 13 | 25.0 | 87.0 |
| 14 | 31.5 | 86.7 |
| 15 | 40.0 | 90.7 |
| 16 | 50.0 | 90.9 |
| 17 | 63.0 | 97.3 |
| 18 | 80.0 | 98.7 |
| 19 | 100.0 | 99.2 |
| 20 | 125.0 | 94.7 |
| 21 | 160.0 | 90.3 |
| 22 | 200.0 | 94.1 |
| 23 | 250.0 | 93.1 |
| 24 | 315.0 | 93.8 |
| 25 | 400.0 | 91.6 |
| 26 | 500.0 | 91.5 |
| 27 | 630.0 | 92.2 |
| 28 | 800.0 | 90.9 |
| 29 | 1000.0 | 89.6 |
| 30 | 1250.0 | 88.2 |
| 31 | 1600.0 | 85.9 |
| 32 | 2000.0 | 87.9 |
| 33 | 2500.0 | 82.6 |
| 34 | 3150.0 | 80.3 |
| 35 | 4000.0 | 77.5 |
| 36 | 5000.0 | 75.7 |
| 37 | 6300.0 | 73.8 |
| 38 | 8000.0 | 72.6 |
| 39 | 10000.0 | 70.6 |
| 40 | 12500.0 | 67.3 |
| 41 | 16000.0 | 65.4 |
| 42 | 20000.0 | 60.0 |

A WEIGHTED LEVEL 99.0dB




Tape#9;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N5 ;Compressor Off

Fan Full;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3Ft/Fan

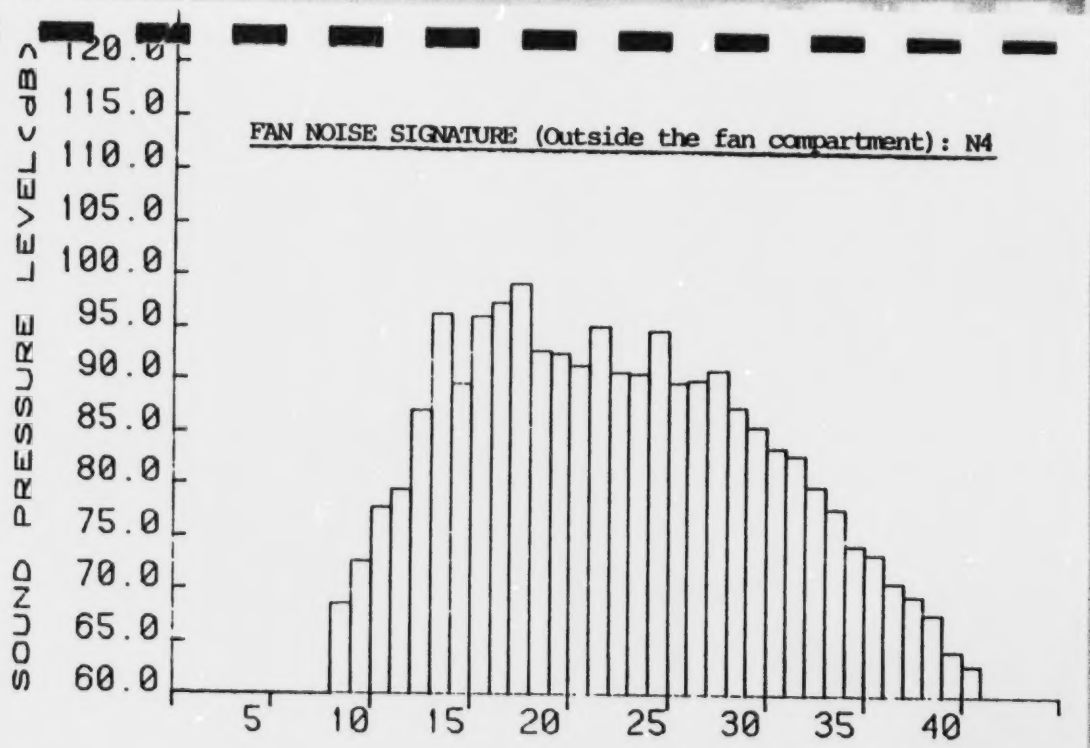
Att:2209=100,Nagra=40

Wind=400gt500 fpm from N.

FIG. 13

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 60.0 |
| 2 | 2.0 | 60.0 |
| 3 | 2.5 | 60.0 |
| 4 | 3.2 | 60.0 |
| 5 | 4.0 | 60.0 |
| 6 | 5.0 | 60.0 |
| 7 | 6.3 | 60.0 |
| 8 | 8.0 | 60.0 |
| 9 | 10.0 | 68.6 |
| 10 | 12.5 | 72.6 |
| 11 | 16.0 | 77.9 |
| 12 | 20.0 | 79.5 |
| 13 | 25.0 | 87.0 |
| 14 | 31.5 | 96.4 |
| 15 | 40.0 | 89.7 |
| 16 | 50.0 | 96.2 |
| 17 | 63.0 | 97.5 |
| 18 | 80.0 | 99.3 |
| 19 | 100.0 | 92.9 |
| 20 | 125.0 | 92.6 |
| 21 | 160.0 | 91.4 |
| 22 | 200.0 | 95.3 |
| 23 | 250.0 | 90.8 |
| 24 | 315.0 | 90.7 |
| 25 | 400.0 | 94.9 |
| 26 | 500.0 | 89.8 |
| 27 | 630.0 | 90.0 |
| 28 | 800.0 | 91.0 |
| 29 | 1000.0 | 87.5 |
| 30 | 1250.0 | 85.6 |
| 31 | 1600.0 | 83.6 |
| 32 | 2000.0 | 82.9 |
| 33 | 2500.0 | 79.9 |
| 34 | 3150.0 | 77.9 |
| 35 | 4000.0 | 74.4 |
| 36 | 5000.0 | 73.4 |
| 37 | 6300.0 | 70.8 |
| 38 | 8000.0 | 69.5 |
| 39 | 10000.0 | 67.8 |
| 40 | 12500.0 | 64.4 |
| 41 | 16000.0 | 63.0 |
| 42 | 20000.0 | 59.3 |

A WEIGHTED LEVEL 97.7dB




Tape#8;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed= N4 ;Compressor Off

Fan Full;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3Ft./Fan

Att:2209=100,Nagra=40

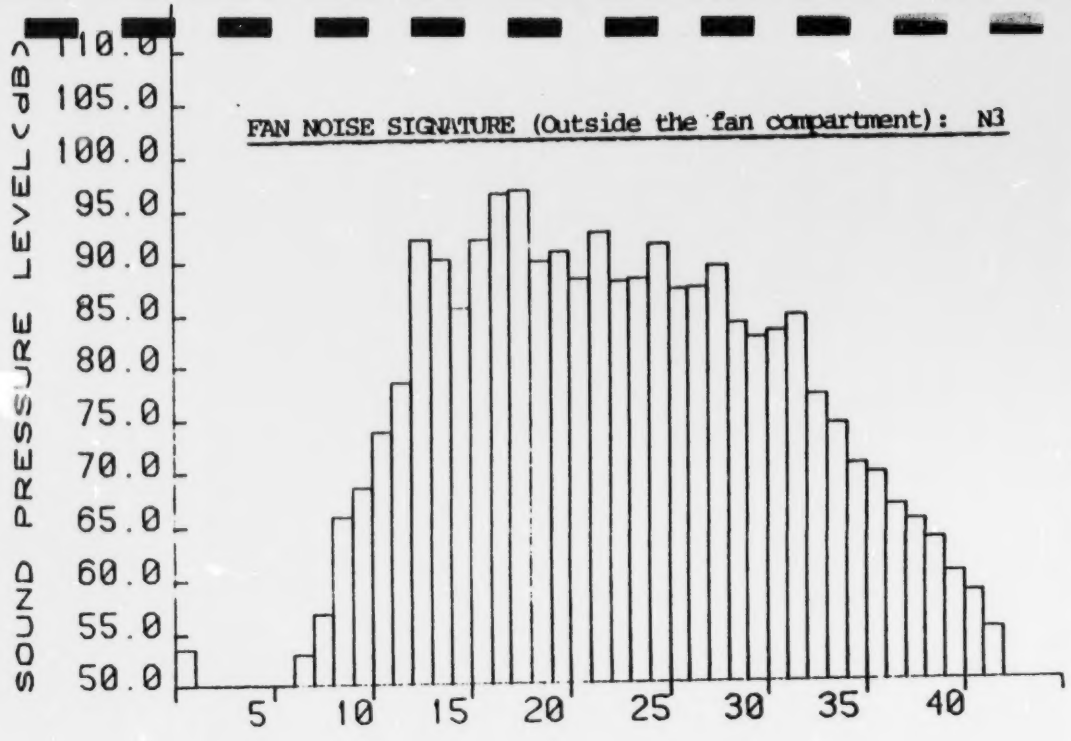
Wind=400gt500 fpm from N.



FIG. 14

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 53.5 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 53.0 |
| 8 | 8.0 | 56.7 |
| 9 | 10.0 | 65.9 |
| 10 | 12.5 | 68.6 |
| 11 | 16.0 | 73.8 |
| 12 | 20.0 | 78.5 |
| 13 | 25.0 | 92.1 |
| 14 | 31.5 | 90.3 |
| 15 | 40.0 | 85.7 |
| 16 | 50.0 | 92.2 |
| 17 | 63.0 | 96.5 |
| 18 | 80.0 | 96.9 |
| 19 | 100.0 | 90.1 |
| 20 | 125.0 | 90.9 |
| 21 | 160.0 | 88.3 |
| 22 | 200.0 | 92.8 |
| 23 | 250.0 | 88.2 |
| 24 | 315.0 | 88.4 |
| 25 | 400.0 | 91.6 |
| 26 | 500.0 | 87.3 |
| 27 | 630.0 | 87.5 |
| 28 | 800.0 | 89.5 |
| 29 | 1000.0 | 84.1 |
| 30 | 1250.0 | 82.6 |
| 31 | 1600.0 | 83.3 |
| 32 | 2000.0 | 84.8 |
| 33 | 2500.0 | 77.0 |
| 34 | 3150.0 | 74.3 |
| 35 | 4000.0 | 70.6 |
| 36 | 5000.0 | 69.7 |
| 37 | 6300.0 | 66.7 |
| 38 | 8000.0 | 65.3 |
| 39 | 10000.0 | 63.5 |
| 40 | 12500.0 | 60.3 |
| 41 | 16000.0 | 58.5 |
| 42 | 20000.0 | 55.0 |

A WEIGHTED LEVEL 95.6dB




Tape#8;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed= N3 ;Compressor Off

Fan Full;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3Ft/Fan

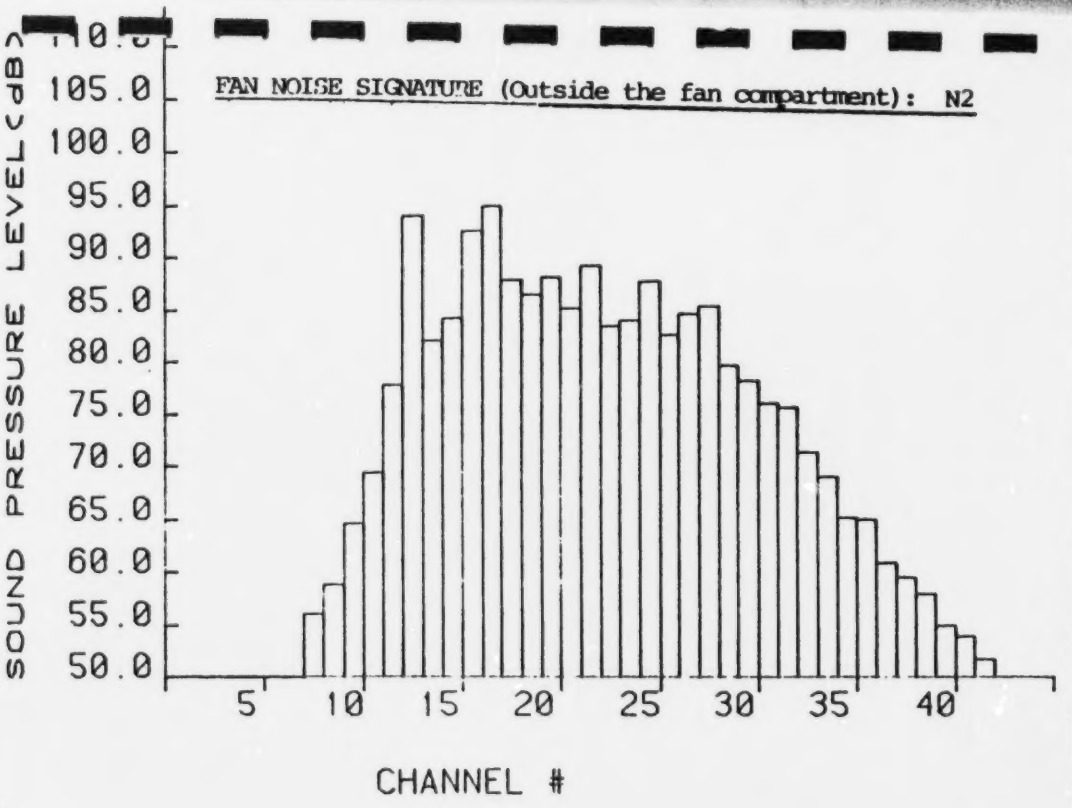
Att:2209=100,Nagra=40

Wind=400gt500 fpm from N

FIG. 15

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 56.0 |
| 9 | 10.0 | 58.9 |
| 10 | 12.5 | 64.7 |
| 11 | 16.0 | 69.6 |
| 12 | 20.0 | 78.0 |
| 13 | 25.0 | 94.2 |
| 14 | 31.5 | 82.2 |
| 15 | 40.0 | 84.5 |
| 16 | 50.0 | 92.8 |
| 17 | 63.0 | 95.1 |
| 18 | 80.0 | 88.2 |
| 19 | 100.0 | 86.7 |
| 20 | 125.0 | 88.3 |
| 21 | 160.0 | 85.4 |
| 22 | 200.0 | 89.5 |
| 23 | 250.0 | 83.7 |
| 24 | 315.0 | 84.2 |
| 25 | 400.0 | 88.0 |
| 26 | 500.0 | 82.8 |
| 27 | 630.0 | 84.9 |
| 28 | 800.0 | 85.5 |
| 29 | 1000.0 | 79.8 |
| 30 | 1250.0 | 78.3 |
| 31 | 1600.0 | 76.2 |
| 32 | 2000.0 | 75.8 |
| 33 | 2500.0 | 71.5 |
| 34 | 3150.0 | 69.1 |
| 35 | 4000.0 | 65.2 |
| 36 | 5000.0 | 65.1 |
| 37 | 6300.0 | 61.0 |
| 38 | 8000.0 | 59.6 |
| 39 | 10000.0 | 57.9 |
| 40 | 12500.0 | 55.0 |
| 41 | 16000.0 | 53.9 |
| 42 | 20000.0 | 51.7 |

A WEIGHTED LEVEL 91.2dB




Tape#8;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed= N2 ;Compressor Off

Fan Full;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3Ft/Fan

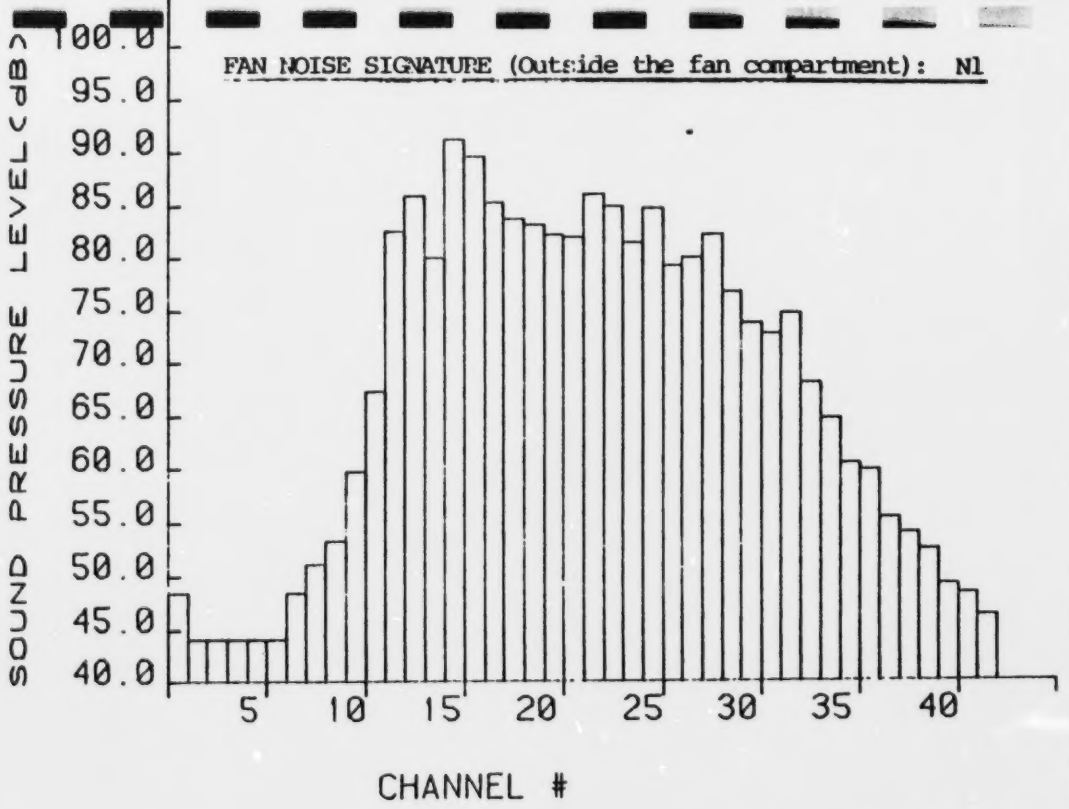
Att:2209=100,Nagra=40

Wind=400gt500 fpm from N

FIG. 16

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 48.4 |
| 2 | 2.0 | 44.0 |
| 3 | 2.5 | 44.0 |
| 4 | 3.2 | 44.0 |
| 5 | 4.0 | 44.0 |
| 6 | 5.0 | 44.0 |
| 7 | 6.3 | 48.4 |
| 8 | 8.0 | 51.0 |
| 9 | 10.0 | 53.3 |
| 10 | 12.5 | 59.7 |
| 11 | 16.0 | 67.3 |
| 12 | 20.0 | 82.5 |
| 13 | 25.0 | 85.9 |
| 14 | 31.5 | 80.1 |
| 15 | 40.0 | 91.3 |
| 16 | 50.0 | 89.6 |
| 17 | 63.0 | 85.2 |
| 18 | 80.0 | 83.7 |
| 19 | 100.0 | 83.1 |
| 20 | 125.0 | 82.3 |
| 21 | 160.0 | 82.0 |
| 22 | 200.0 | 86.1 |
| 23 | 250.0 | 84.9 |
| 24 | 315.0 | 81.5 |
| 25 | 400.0 | 84.7 |
| 26 | 500.0 | 79.3 |
| 27 | 630.0 | 80.0 |
| 28 | 800.0 | 82.3 |
| 29 | 1000.0 | 76.8 |
| 30 | 1250.0 | 73.8 |
| 31 | 1600.0 | 72.8 |
| 32 | 2000.0 | 74.8 |
| 33 | 2500.0 | 68.1 |
| 34 | 3150.0 | 64.7 |
| 35 | 4000.0 | 60.6 |
| 36 | 5000.0 | 59.9 |
| 37 | 6300.0 | 55.5 |
| 38 | 8000.0 | 54.1 |
| 39 | 10000.0 | 52.5 |
| 40 | 12500.0 | 49.3 |
| 41 | 16000.0 | 48.3 |
| 42 | 20000.0 | 46.3 |

A WEIGHTED LEVEL 87.9dB




Tape#8;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N1 ;Compressor Off

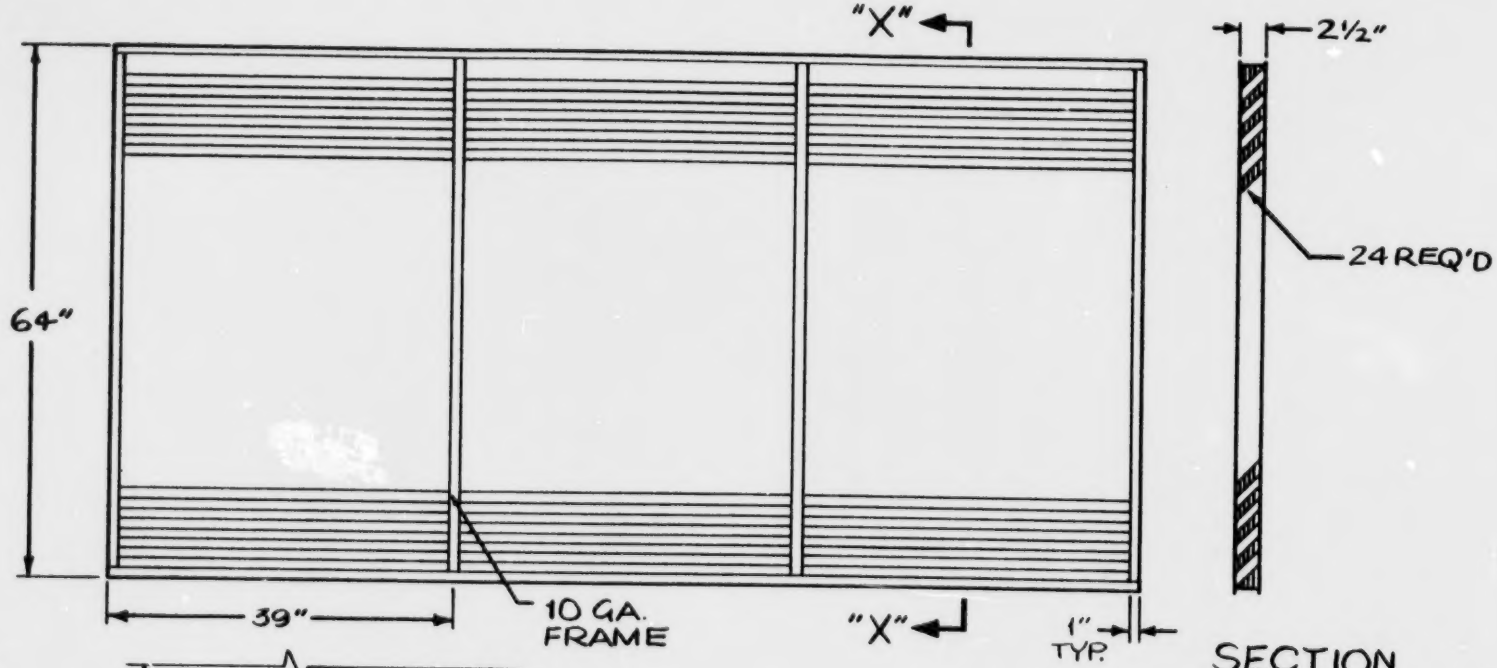
Fan Full;Eng Loaded;78/08/24;1300hr

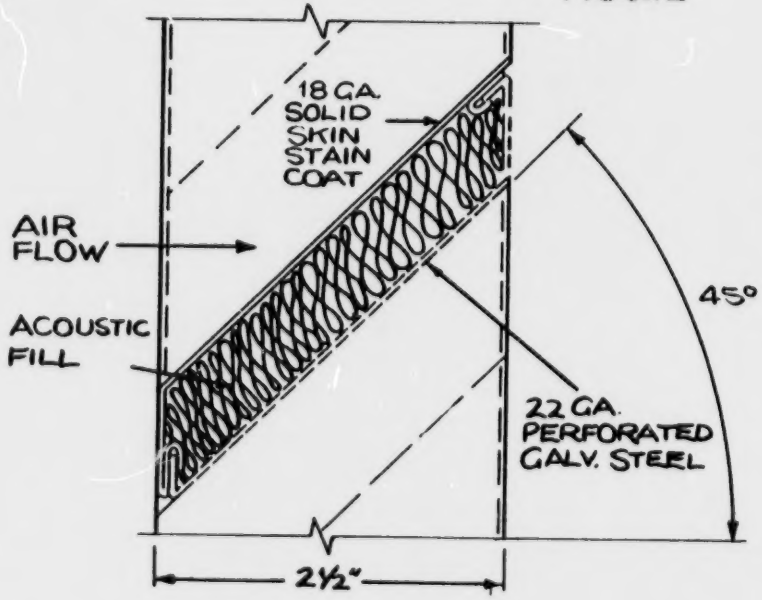
Mic Ht=3ft;Mic Pos=3Ft/Fan

Att:2209=90,Nagra=44

Wind=400gt500 fpm from N.

FIG. 17




# ACOUSTIC LOUVER

# DYNAMIC BRAKE BLOWER NOISE SIGNATURE(MEASURED AT 3 FT.FROM DB.UNIT LOCATED 300FT.FROM LOCO)

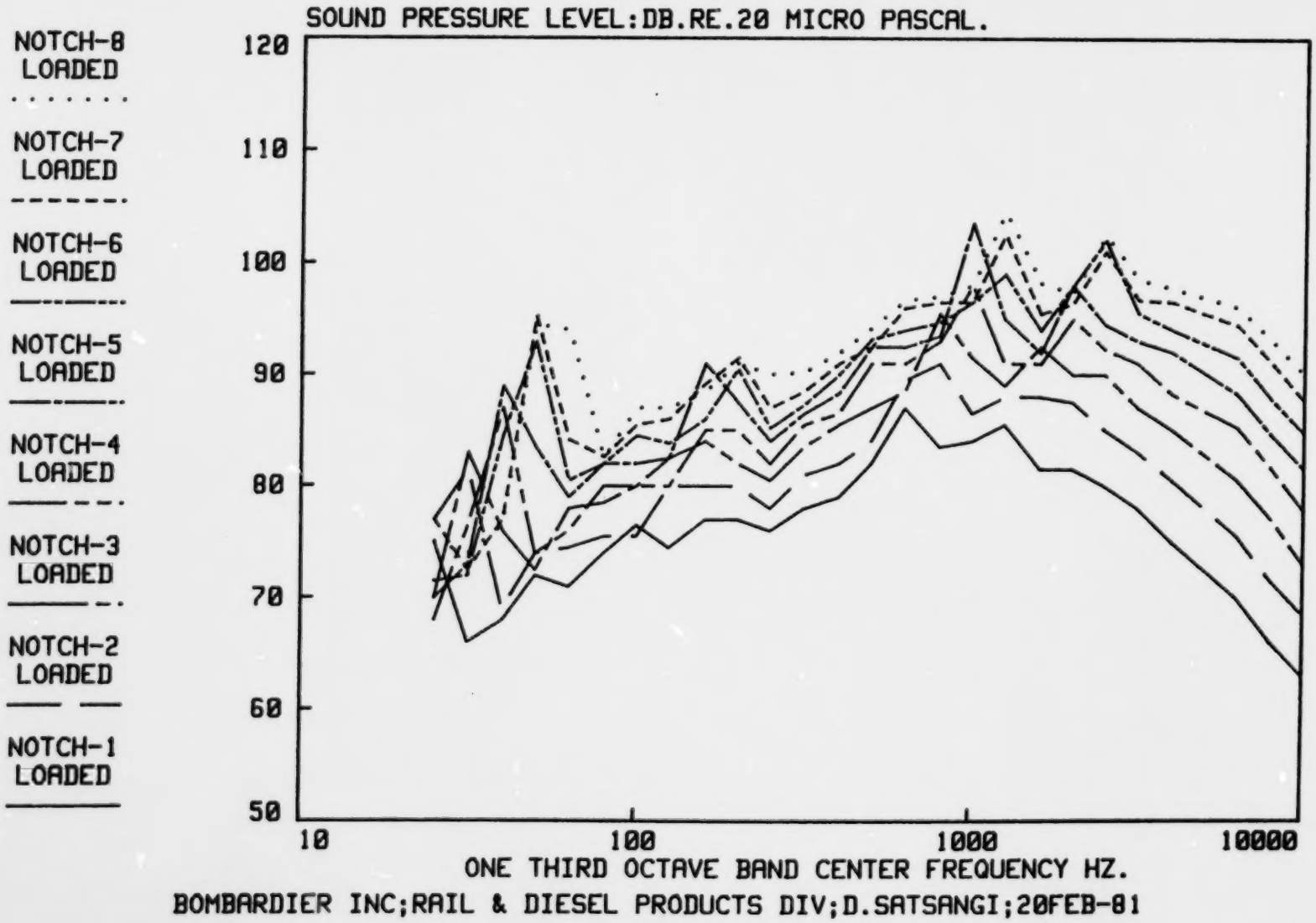



FIG. 19

# PRIMARY AIR INTAKE NOISE SPECTRUM
# (3FT.FROM FILTER;N–8;F.L;FAN ON;COMPR. OFF.)

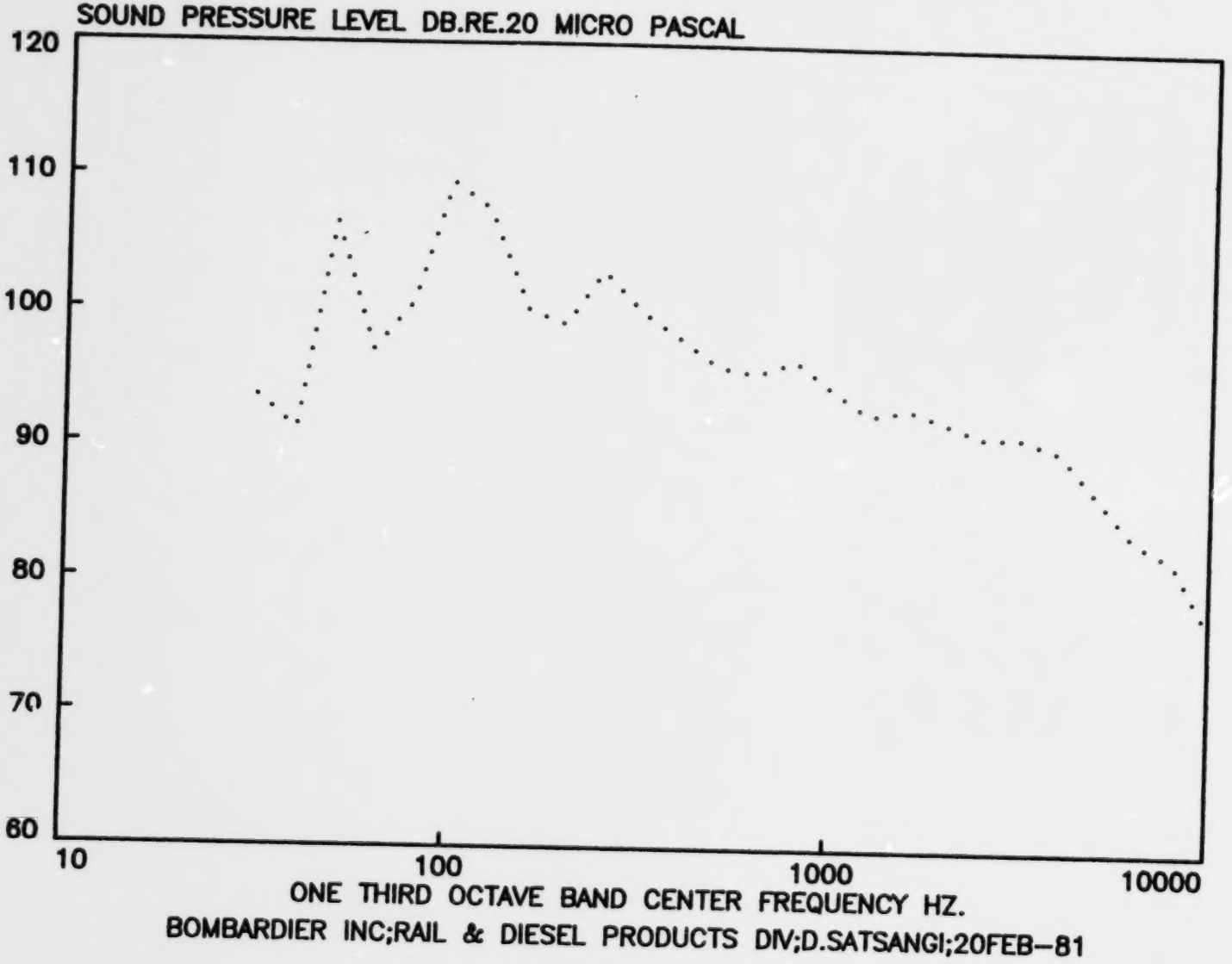



FIG. 20

# TRACTION MOTOR BLOWER NOISE(DOOR OPEN;MIC.@ 3FT.FROM SOURCE;FAN OFF;COMPRESSOR OFF;N.L.)

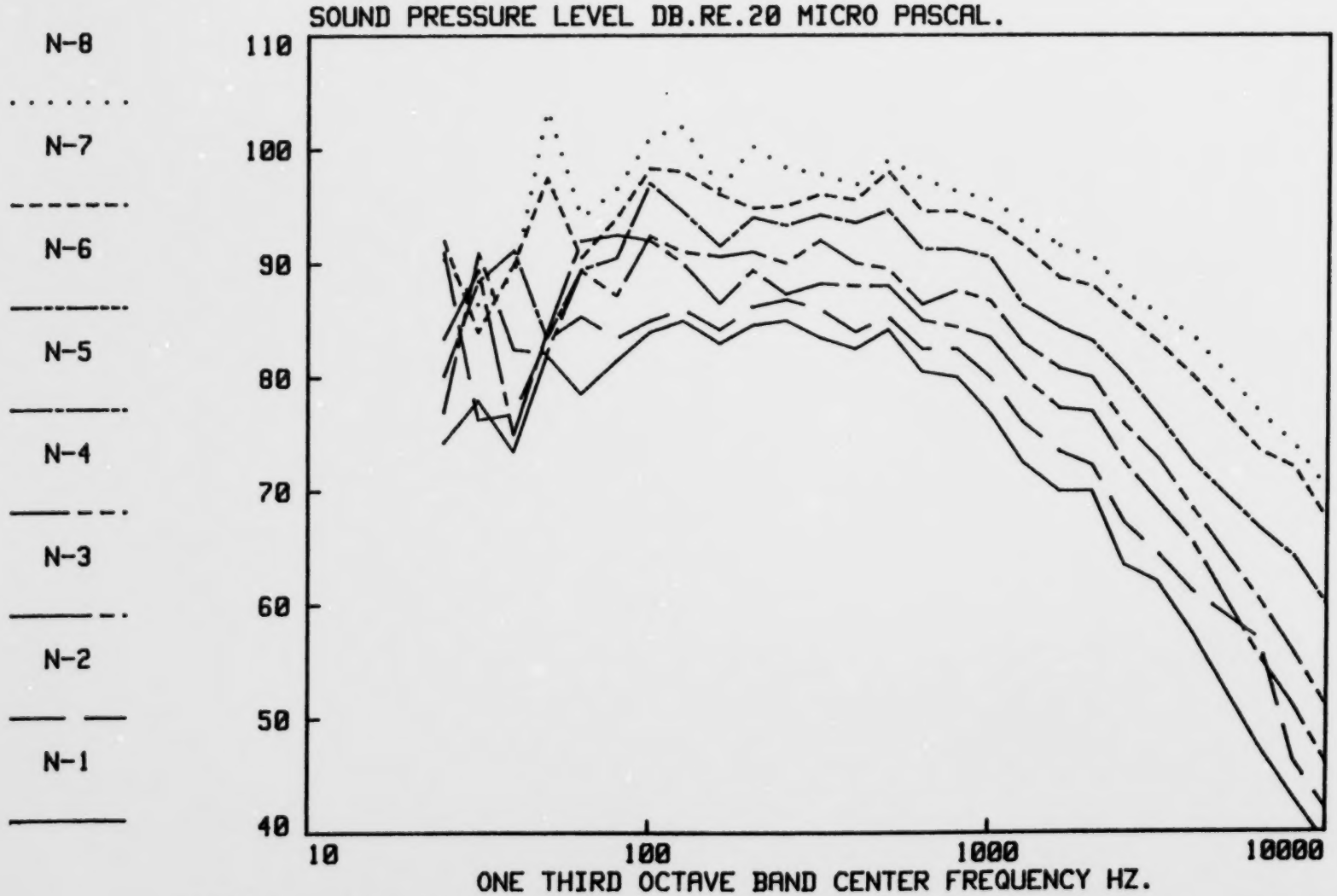



FIG. 21

# SOURCE NOISE MEASUREMENT AT 1FT.FROM THE TURBO HATCH(N-8;FULL LOAD)

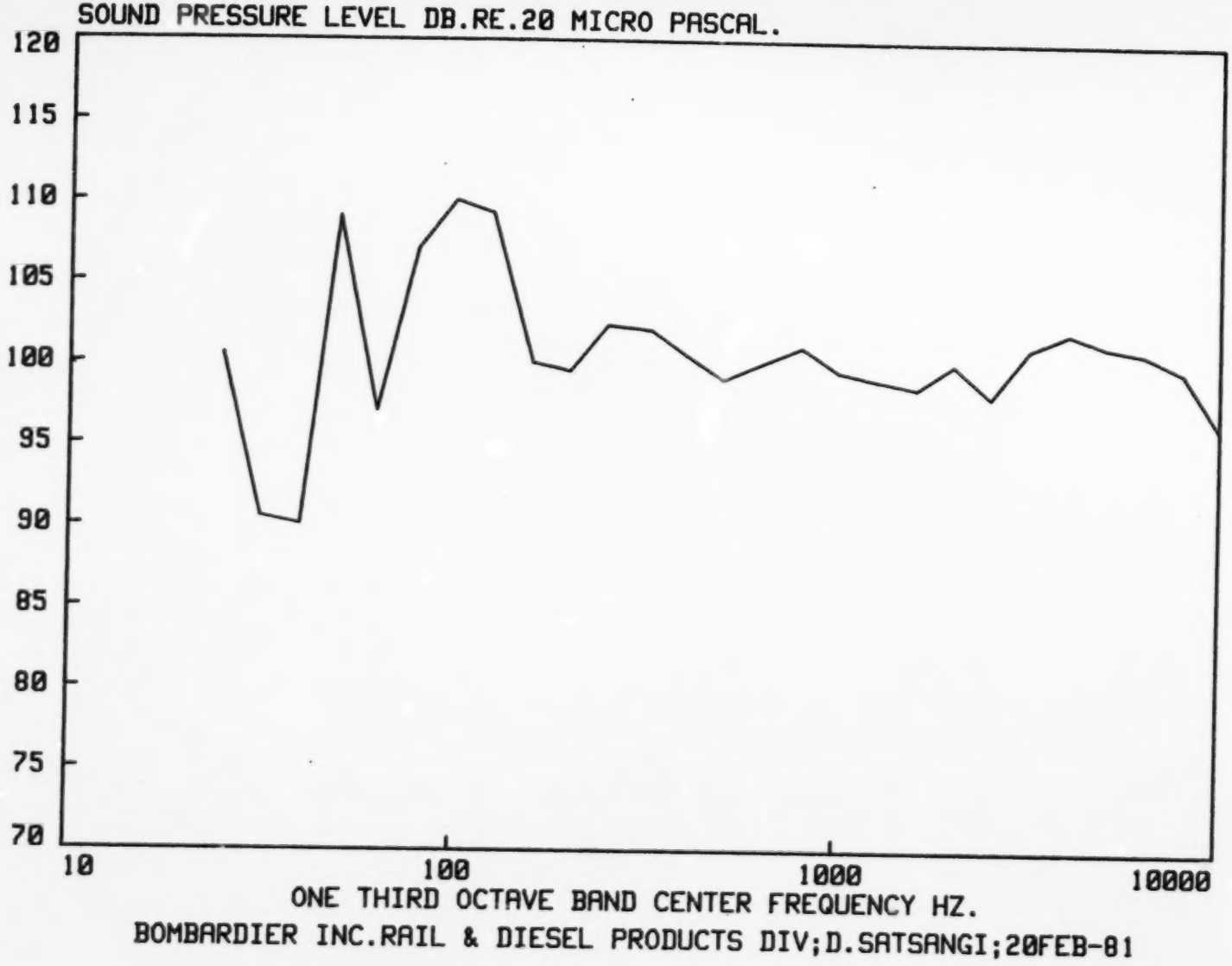



FIG. 22

# M420 COMPRESSOR NOISE SIGNATURE(MEASURED 3FT. FROM THE COMPRESSOR WITH DOORS CLOSED)

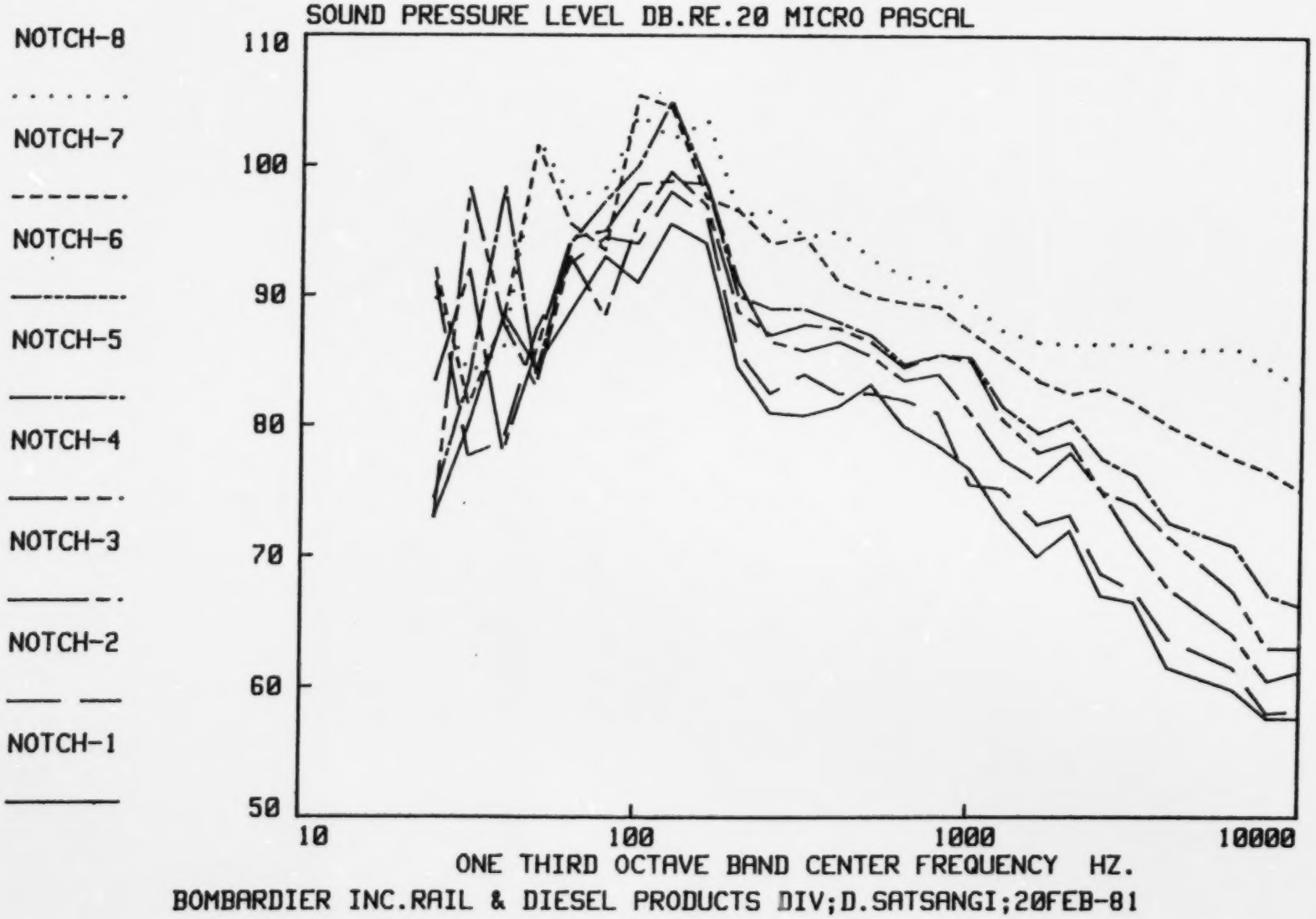
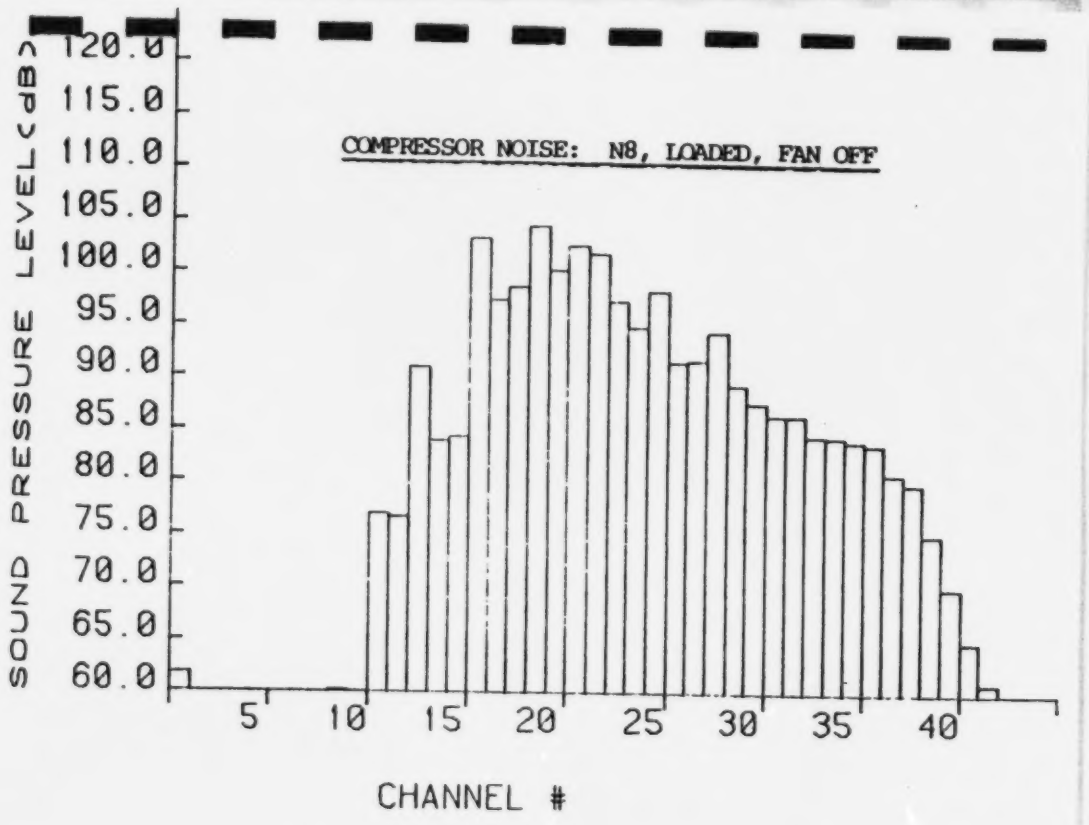



FIG. 23

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 61.8 |
| 2 | 2.0 | 60.0 |
| 3 | 2.5 | 60.0 |
| 4 | 3.2 | 60.0 |
| 5 | 4.0 | 60.0 |
| 6 | 5.0 | 60.0 |
| 7 | 6.3 | 60.0 |
| 8 | 8.0 | 60.0 |
| 9 | 10.0 | 60.2 |
| 10 | 12.5 | 60.0 |
| 11 | 16.0 | 77.0 |
| 12 | 20.0 | 76.7 |
| 13 | 25.0 | 91.0 |
| 14 | 31.5 | 83.9 |
| 15 | 40.0 | 84.3 |
| 16 | 50.0 | 103.3 |
| 17 | 63.0 | 97.5 |
| 18 | 80.0 | 98.8 |
| 19 | 100.0 | 104.5 |
| 20 | 125.0 | 100.3 |
| 21 | 160.0 | 102.6 |
| 22 | 200.0 | 101.9 |
| 23 | 250.0 | 97.4 |
| 24 | 315.0 | 94.8 |
| 25 | 400.0 | 98.2 |
| 26 | 500.0 | 91.4 |
| 27 | 630.0 | 91.6 |
| 28 | 800.0 | 94.3 |
| 29 | 1000.0 | 89.3 |
| 30 | 1250.0 | 87.5 |
| 31 | 1600.0 | 86.4 |
| 32 | 2000.0 | 86.5 |
| 33 | 2500.0 | 84.4 |
| 34 | 3150.0 | 84.3 |
| 35 | 4000.0 | 84.0 |
| 36 | 5000.0 | 83.7 |
| 37 | 6300.0 | 80.8 |
| 38 | 8000.0 | 79.9 |
| 39 | 10000.0 | 75.1 |
| 40 | 12500.0 | 70.1 |
| 41 | 16000.0 | 64.9 |
| 42 | 20000.0 | 61.1 |

A WEIGHTED LEVEL 101.6dB




Tape#8;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N8 ;Compressor On

Fan Off;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3Ft/Comp Compart

Att:2209=110,Nagra=40

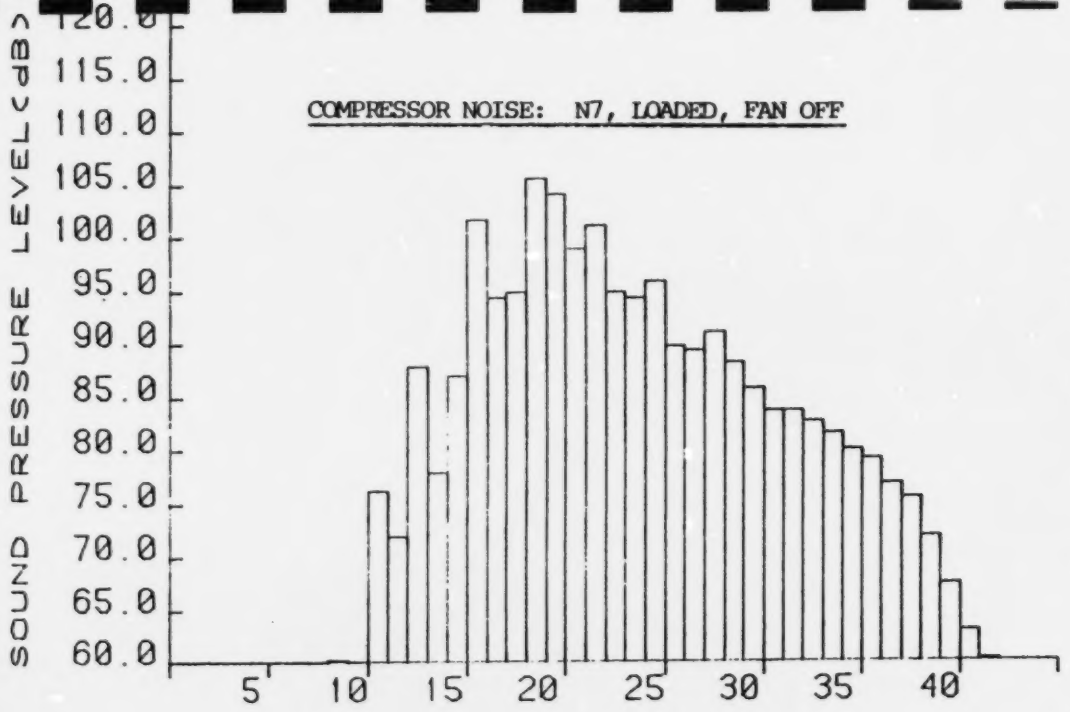
Wind=400gt500 fpm from N.



FIG. 24

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 60.0 |
| 2 | 2.0 | 60.0 |
| 3 | 2.5 | 60.0 |
| 4 | 3.2 | 60.0 |
| 5 | 4.0 | 60.0 |
| 6 | 5.0 | 60.0 |
| 7 | 6.3 | 60.0 |
| 8 | 8.0 | 60.0 |
| 9 | 10.0 | 60.2 |
| 10 | 12.5 | 60.0 |
| 11 | 16.0 | 76.3 |
| 12 | 20.0 | 71.9 |
| 13 | 25.0 | 88.0 |
| 14 | 31.5 | 78.0 |
| 15 | 40.0 | 87.1 |
| 16 | 50.0 | 101.8 |
| 17 | 63.0 | 94.5 |
| 18 | 80.0 | 95.0 |
| 19 | 100.0 | 105.6 |
| 20 | 125.0 | 104.2 |
| 21 | 160.0 | 99.0 |
| 22 | 200.0 | 101.2 |
| 23 | 250.0 | 95.0 |
| 24 | 315.0 | 94.5 |
| 25 | 400.0 | 96.0 |
| 26 | 500.0 | 89.9 |
| 27 | 630.0 | 89.5 |
| 28 | 800.0 | 91.2 |
| 29 | 1000.0 | 88.4 |
| 30 | 1250.0 | 85.9 |
| 31 | 1600.0 | 83.9 |
| 32 | 2000.0 | 83.9 |
| 33 | 2500.0 | 82.8 |
| 34 | 3150.0 | 81.7 |
| 35 | 4000.0 | 80.2 |
| 36 | 5000.0 | 79.3 |
| 37 | 6300.0 | 77.0 |
| 38 | 8000.0 | 75.6 |
| 39 | 10000.0 | 71.9 |
| 40 | 12500.0 | 67.4 |
| 41 | 16000.0 | 63.0 |
| 42 | 20000.0 | 60.3 |

A WEIGHTED LEVEL 99.8dB




Tape#8;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N7 ;Compressor On

Fan Off;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3Ft/Comp Compart

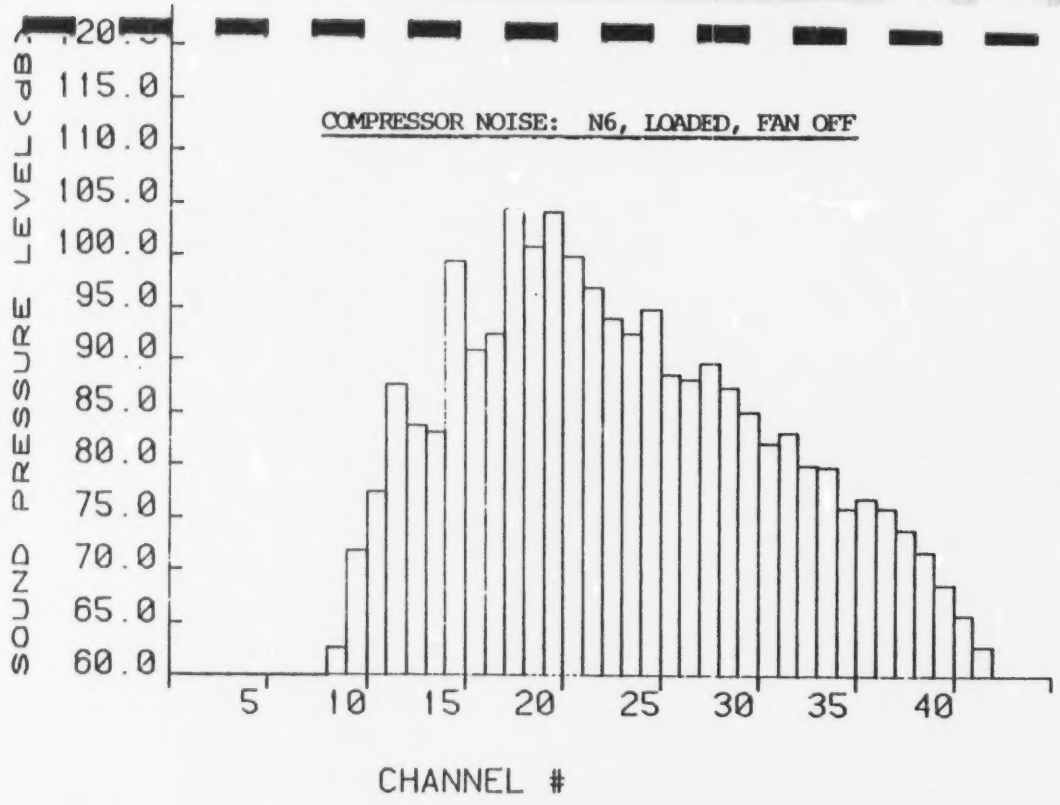
Att:2209=110,Nagra=40

Wind=400gt500 fpm from N.

FIG. 25

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 60.0 |
| 2 | 2.0 | 60.0 |
| 3 | 2.5 | 60.0 |
| 4 | 3.2 | 60.0 |
| 5 | 4.0 | 60.0 |
| 6 | 5.0 | 60.0 |
| 7 | 6.3 | 60.0 |
| 8 | 8.0 | 60.0 |
| 9 | 10.0 | 62.6 |
| 10 | 12.5 | 71.8 |
| 11 | 16.0 | 77.5 |
| 12 | 20.0 | 87.7 |
| 13 | 25.0 | 83.8 |
| 14 | 31.5 | 83.2 |
| 15 | 40.0 | 99.6 |
| 16 | 50.0 | 91.1 |
| 17 | 63.0 | 92.6 |
| 18 | 80.0 | 104.7 |
| 19 | 100.0 | 100.9 |
| 20 | 125.0 | 104.3 |
| 21 | 160.0 | 100.0 |
| 22 | 200.0 | 97.1 |
| 23 | 250.0 | 94.1 |
| 24 | 315.0 | 92.6 |
| 25 | 400.0 | 95.0 |
| 26 | 500.0 | 88.7 |
| 27 | 630.0 | 88.2 |
| 28 | 800.0 | 89.8 |
| 29 | 1000.0 | 87.5 |
| 30 | 1250.0 | 85.1 |
| 31 | 1600.0 | 82.2 |
| 32 | 2000.0 | 83.2 |
| 33 | 2500.0 | 80.0 |
| 34 | 3150.0 | 79.9 |
| 35 | 4000.0 | 76.1 |
| 36 | 5000.0 | 77.0 |
| 37 | 6300.0 | 76.0 |
| 38 | 8000.0 | 74.0 |
| 39 | 10000.0 | 71.8 |
| 40 | 12500.0 | 68.7 |
| 41 | 16000.0 | 65.8 |
| 42 | 20000.0 | 62.8 |

A WEIGHTED LEVEL 98.5dB




Tape#7;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N6 ;Compressor On

Fan Off;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3Ft./Comp Compart

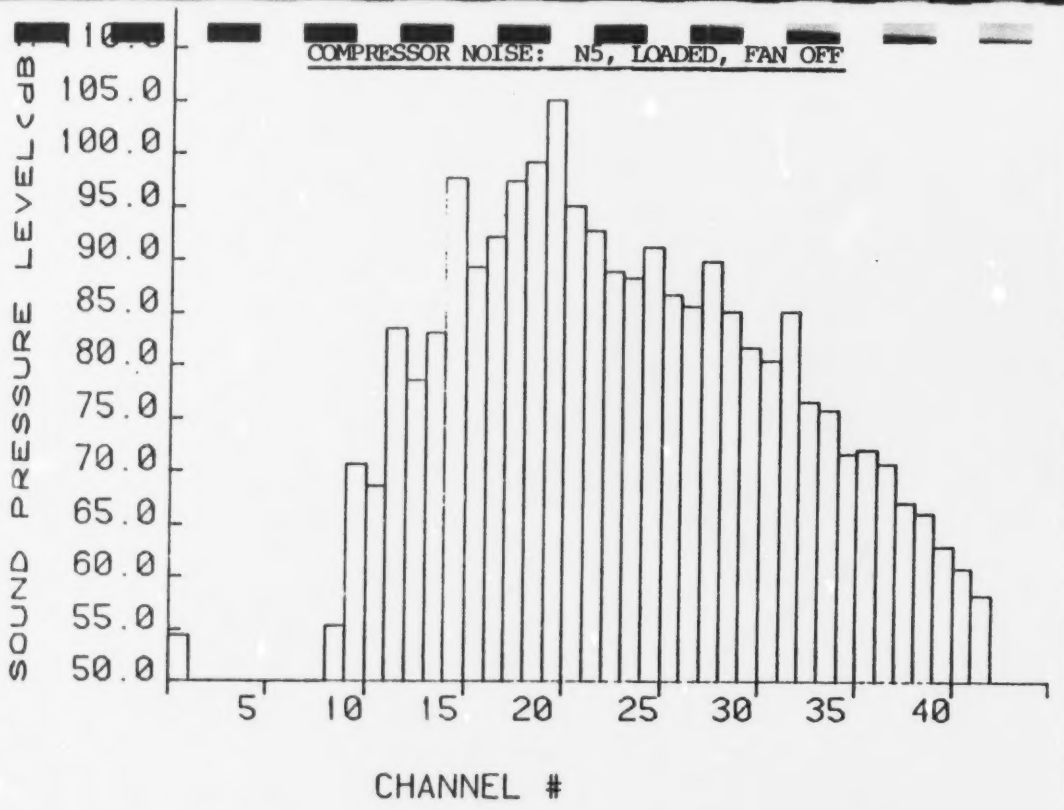
Att:2209=110,Nagra=40

Wind=400gt500 fpm from N.

FIG. 26

| CH. # | FREQ Hz | LEVEL (dB) |
|---|---|---|
| 1 | 1.6 | 54.4 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 50.0 |
| 9 | 10.0 | 55.3 |
| 10 | 12.5 | 70.7 |
| 11 | 16.0 | 68.6 |
| 12 | 20.0 | 83.5 |
| 13 | 25.0 | 78.6 |
| 14 | 31.5 | 83.2 |
| 15 | 40.0 | 97.9 |
| 16 | 50.0 | 89.5 |
| 17 | 63.0 | 92.2 |
| 18 | 80.0 | 97.6 |
| 19 | 100.0 | 99.4 |
| 20 | 125.0 | 105.3 |
| 21 | 160.0 | 95.2 |
| 22 | 200.0 | 93.0 |
| 23 | 250.0 | 89.1 |
| 24 | 315.0 | 88.3 |
| 25 | 400.0 | 91.4 |
| 26 | 500.0 | 86.8 |
| 27 | 630.0 | 85.8 |
| 28 | 800.0 | 90.0 |
| 29 | 1000.0 | 85.3 |
| 30 | 1250.0 | 81.9 |
| 31 | 1600.0 | 80.6 |
| 32 | 2000.0 | 85.3 |
| 33 | 2500.0 | 76.6 |
| 34 | 3150.0 | 75.9 |
| 35 | 4000.0 | 71.8 |
| 36 | 5000.0 | 72.2 |
| 37 | 6300.0 | 70.8 |
| 38 | 8000.0 | 67.2 |
| 39 | 10000.0 | 66.1 |
| 40 | 12500.0 | 63.0 |
| 41 | 16000.0 | 60.9 |
| 42 | 20000.0 | 58.3 |

A WEIGHTED LEVEL 96.6dB




Tape#7;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N5 ;Compressor On

Fan Off;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3Ft/Comp Compart

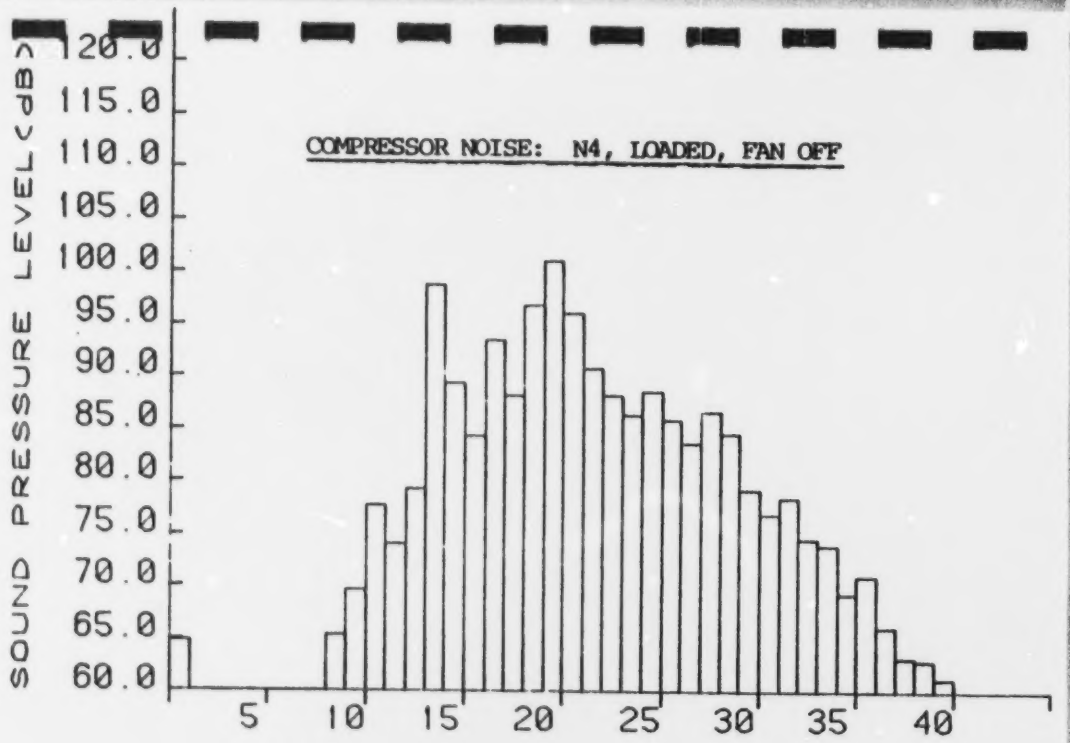
Att:2209=100,Nagra=40

Wind=400gt500 fpm from N.

FIG. 27

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 64.8 |
| 2 | 2.0 | 60.0 |
| 3 | 2.5 | 60.0 |
| 4 | 3.2 | 60.0 |
| 5 | 4.0 | 60.0 |
| 6 | 5.0 | 60.0 |
| 7 | 6.3 | 60.0 |
| 8 | 8.0 | 60.0 |
| 9 | 10.0 | 65.3 |
| 10 | 12.5 | 69.6 |
| 11 | 16.0 | 77.7 |
| 12 | 20.0 | 74.1 |
| 13 | 25.0 | 79.2 |
| 14 | 31.5 | 98.9 |
| 15 | 40.0 | 89.4 |
| 16 | 50.0 | 84.3 |
| 17 | 63.0 | 93.5 |
| 18 | 80.0 | 88.2 |
| 19 | 100.0 | 96.9 |
| 20 | 125.0 | 101.2 |
| 21 | 160.0 | 96.1 |
| 22 | 200.0 | 90.8 |
| 23 | 250.0 | 88.2 |
| 24 | 315.0 | 86.4 |
| 25 | 400.0 | 88.6 |
| 26 | 500.0 | 85.9 |
| 27 | 630.0 | 83.7 |
| 28 | 800.0 | 86.6 |
| 29 | 1000.0 | 84.6 |
| 30 | 1250.0 | 79.3 |
| 31 | 1600.0 | 77.0 |
| 32 | 2000.0 | 78.5 |
| 33 | 2500.0 | 74.5 |
| 34 | 3150.0 | 74.0 |
| 35 | 4000.0 | 69.4 |
| 36 | 5000.0 | 71.1 |
| 37 | 6300.0 | 66.1 |
| 38 | 8000.0 | 63.3 |
| 39 | 10000.0 | 63.0 |
| 40 | 12500.0 | 61.4 |
| 41 | 16000.0 | 59.5 |
| 42 | 20000.0 | 59.3 |

A WEIGHTED LEVEL 93.9dB




Tape#7;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N4 ;Compressor On

Fan Off;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3Ft/Comp Compart

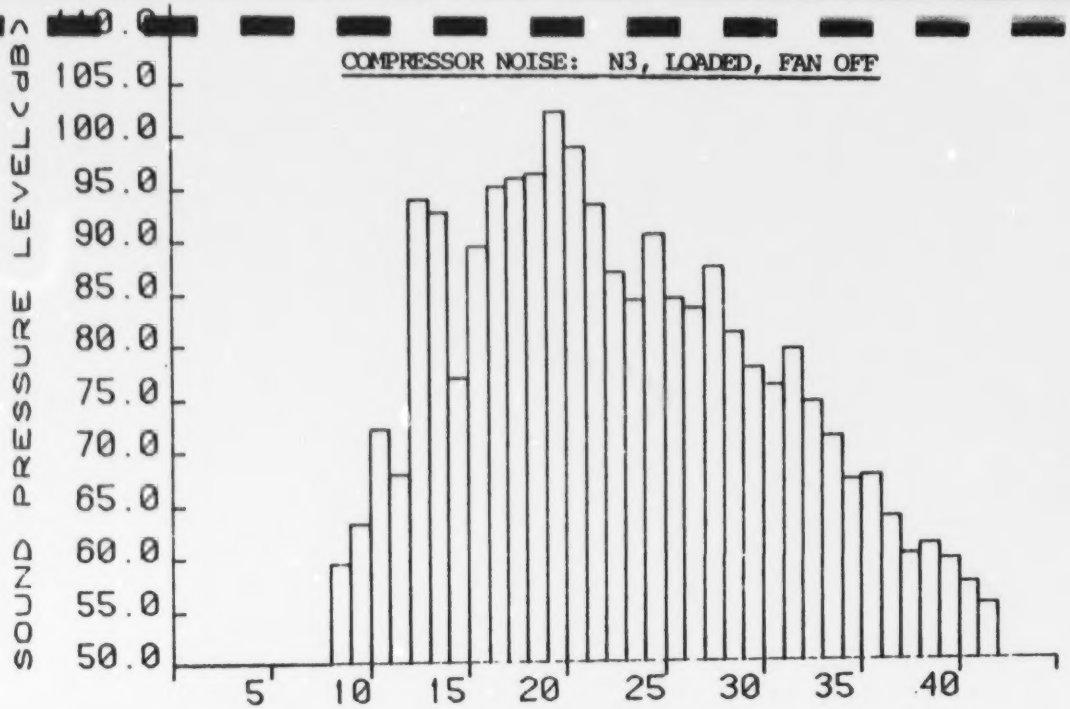
Att:2209=100,Nagra=40

Wind=400gt500 fpm from N.

FIG. 28

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 50.0 |
| 9 | 10.0 | 59.5 |
| 10 | 12.5 | 63.3 |
| 11 | 16.0 | 72.2 |
| 12 | 20.0 | 67.8 |
| 13 | 25.0 | 94.0 |
| 14 | 31.5 | 92.6 |
| 15 | 40.0 | 76.9 |
| 16 | 50.0 | 89.5 |
| 17 | 63.0 | 95.1 |
| 18 | 80.0 | 95.9 |
| 19 | 100.0 | 96.3 |
| 20 | 125.0 | 102.1 |
| 21 | 160.0 | 98.7 |
| 22 | 200.0 | 93.3 |
| 23 | 250.0 | 86.9 |
| 24 | 315.0 | 84.2 |
| 25 | 400.0 | 90.4 |
| 26 | 500.0 | 84.3 |
| 27 | 630.0 | 83.4 |
| 28 | 800.0 | 87.3 |
| 29 | 1000.0 | 81.1 |
| 30 | 1250.0 | 77.7 |
| 31 | 1600.0 | 76.0 |
| 32 | 2000.0 | 79.5 |
| 33 | 2500.0 | 74.5 |
| 34 | 3150.0 | 71.2 |
| 35 | 4000.0 | 67.2 |
| 36 | 5000.0 | 67.6 |
| 37 | 6300.0 | 63.7 |
| 38 | 8000.0 | 60.2 |
| 39 | 10000.0 | 61.0 |
| 40 | 12500.0 | 59.7 |
| 41 | 16000.0 | 57.4 |
| 42 | 20000.0 | 55.3 |

A WEIGHTED LEVEL 94.2dB




Tape#7;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N3 ;Compressor On

Fan Off;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3Ft/Comp Compart

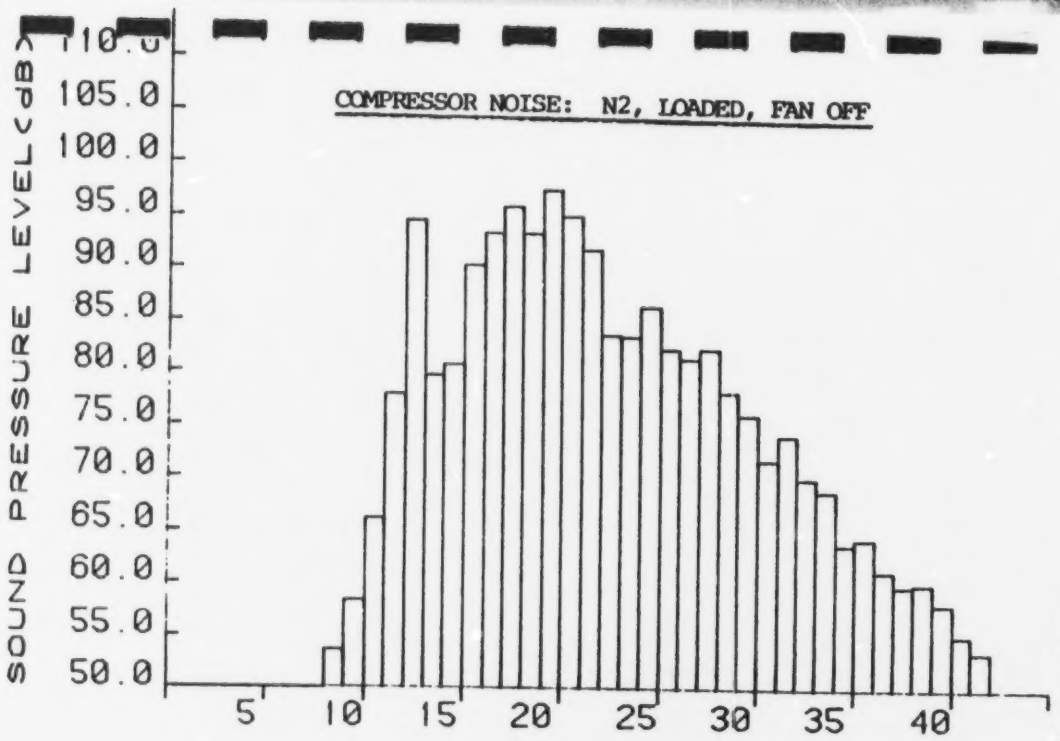
Att:2209=100,Nagra=40

Wind=400gt500 fpm from N.

FIG. 29

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 50.0 |
| 9 | 10.0 | 53.7 |
| 10 | 12.5 | 58.3 |
| 11 | 16.0 | 66.2 |
| 12 | 20.0 | 77.9 |
| 13 | 25.0 | 94.7 |
| 14 | 31.5 | 79.8 |
| 15 | 40.0 | 80.8 |
| 16 | 50.0 | 90.5 |
| 17 | 63.0 | 93.6 |
| 18 | 80.0 | 96.1 |
| 19 | 100.0 | 93.4 |
| 20 | 125.0 | 97.6 |
| 21 | 160.0 | 95.1 |
| 22 | 200.0 | 91.9 |
| 23 | 250.0 | 83.7 |
| 24 | 315.0 | 83.5 |
| 25 | 400.0 | 86.4 |
| 26 | 500.0 | 82.4 |
| 27 | 630.0 | 81.5 |
| 28 | 800.0 | 82.4 |
| 29 | 1000.0 | 78.3 |
| 30 | 1250.0 | 76.0 |
| 31 | 1600.0 | 71.7 |
| 32 | 2000.0 | 74.1 |
| 33 | 2500.0 | 70.0 |
| 34 | 3150.0 | 68.9 |
| 35 | 4000.0 | 63.8 |
| 36 | 5000.0 | 64.4 |
| 37 | 6300.0 | 61.4 |
| 38 | 8000.0 | 59.9 |
| 39 | 10000.0 | 60.2 |
| 40 | 12500.0 | 58.3 |
| 41 | 16000.0 | 55.2 |
| 42 | 20000.0 | 53.7 |

A WEIGHTED LEVEL 90.8dB




Tape#7;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N2 ;Compressor On

Fan Off;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3 Ft/Comp Compart

Att:2209=100;Nagra=40

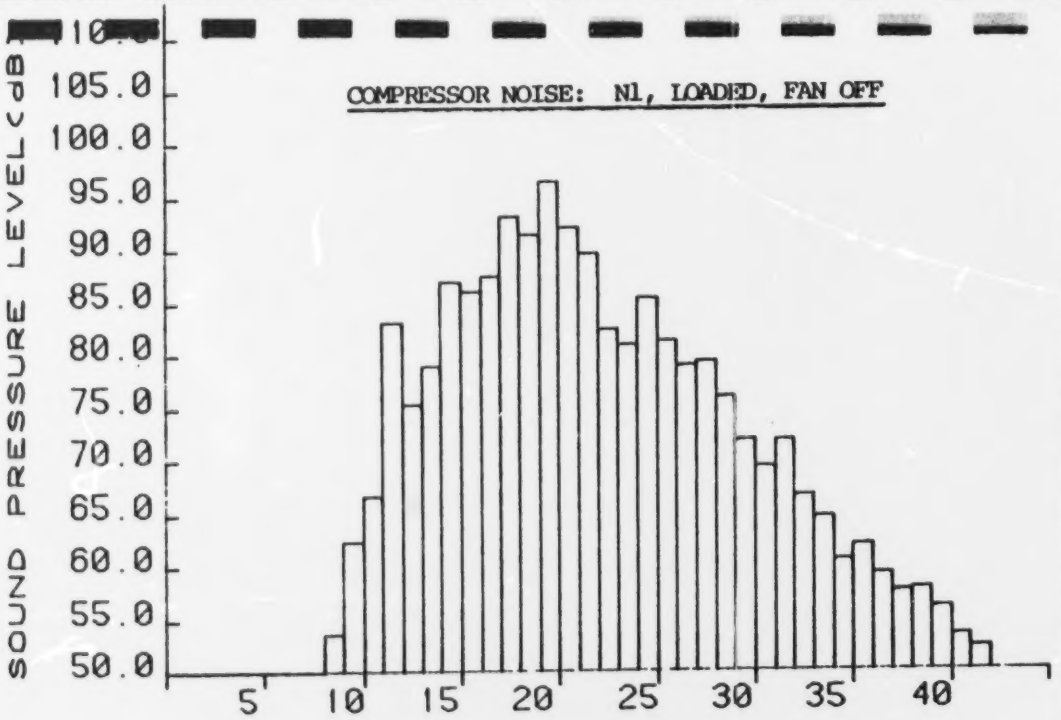
Wind=400gt500 fpm from N.



FIG. 30

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 50.0 |
| 9 | 10.0 | 53.7 |
| 10 | 12.5 | 62.3 |
| 11 | 16.0 | 66.7 |
| 12 | 20.0 | 83.2 |
| 13 | 25.0 | 75.4 |
| 14 | 31.5 | 79.0 |
| 15 | 40.0 | 87.1 |
| 16 | 50.0 | 86.2 |
| 17 | 63.0 | 87.6 |
| 18 | 80.0 | 93.3 |
| 19 | 100.0 | 91.6 |
| 20 | 125.0 | 96.7 |
| 21 | 160.0 | 92.2 |
| 22 | 200.0 | 89.8 |
| 23 | 250.0 | 82.5 |
| 24 | 315.0 | 81.1 |
| 25 | 400.0 | 85.5 |
| 26 | 500.0 | 81.4 |
| 27 | 630.0 | 79.1 |
| 28 | 800.0 | 79.5 |
| 29 | 1000.0 | 76.2 |
| 30 | 1250.0 | 72.0 |
| 31 | 1600.0 | 69.6 |
| 32 | 2000.0 | 72.0 |
| 33 | 2500.0 | 66.8 |
| 34 | 3150.0 | 64.7 |
| 35 | 4000.0 | 60.7 |
| 36 | 5000.0 | 62.2 |
| 37 | 6300.0 | 59.4 |
| 38 | 8000.0 | 57.7 |
| 39 | 10000.0 | 57.9 |
| 40 | 12500.0 | 56.1 |
| 41 | 16000.0 | 53.5 |
| 42 | 20000.0 | 52.3 |

A WEIGHTED LEVEL 88.9dB




Tape#7;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N1 ;Compressor On

Fan Off;Eng Loaded;78/08/24;1300hr

Mic Ht=3ft;Mic Pos=3Ft/Comp Compart

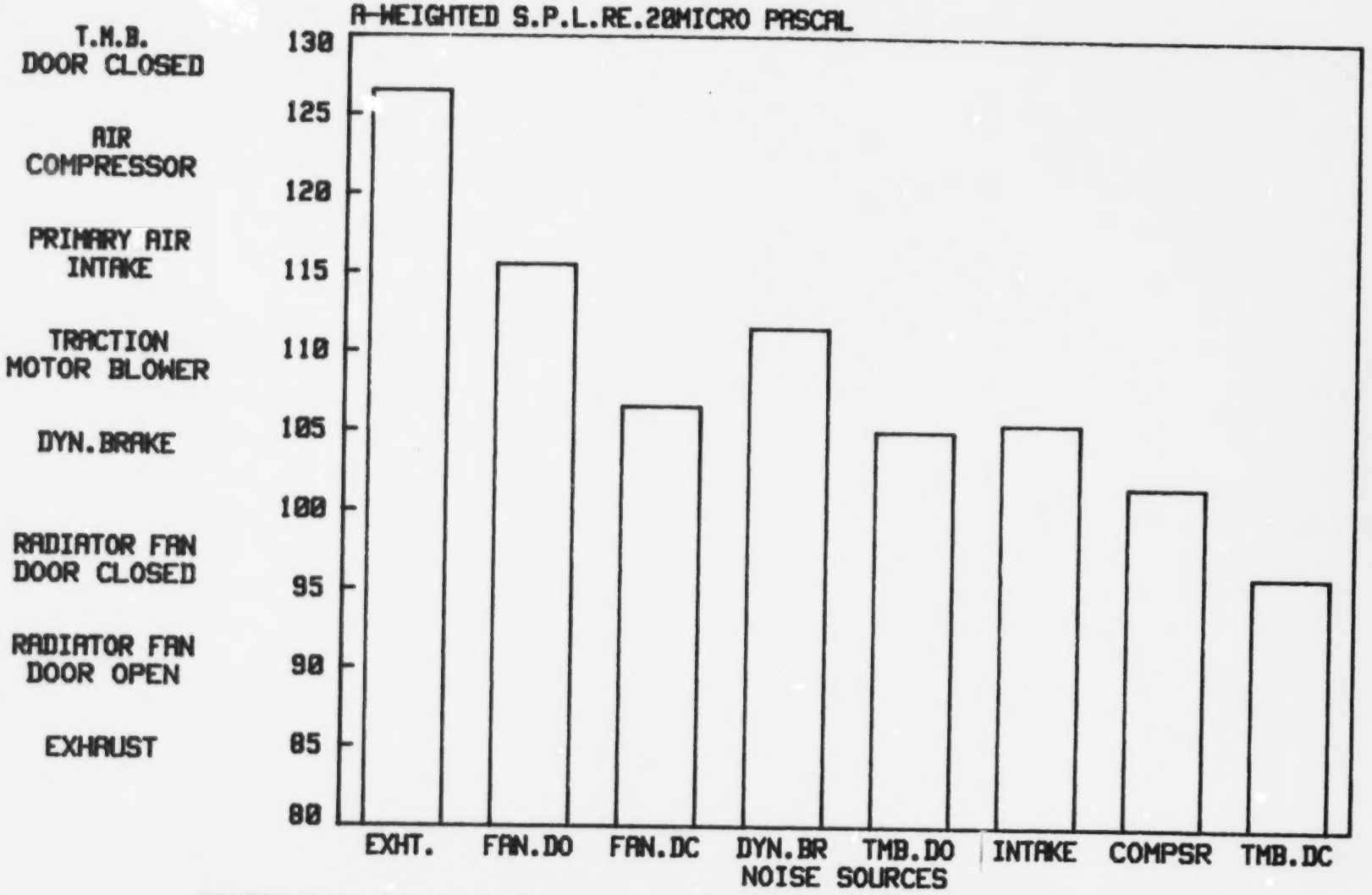
Att:2209=100,Nagra=40

Wind=400gt500 fpm from N.



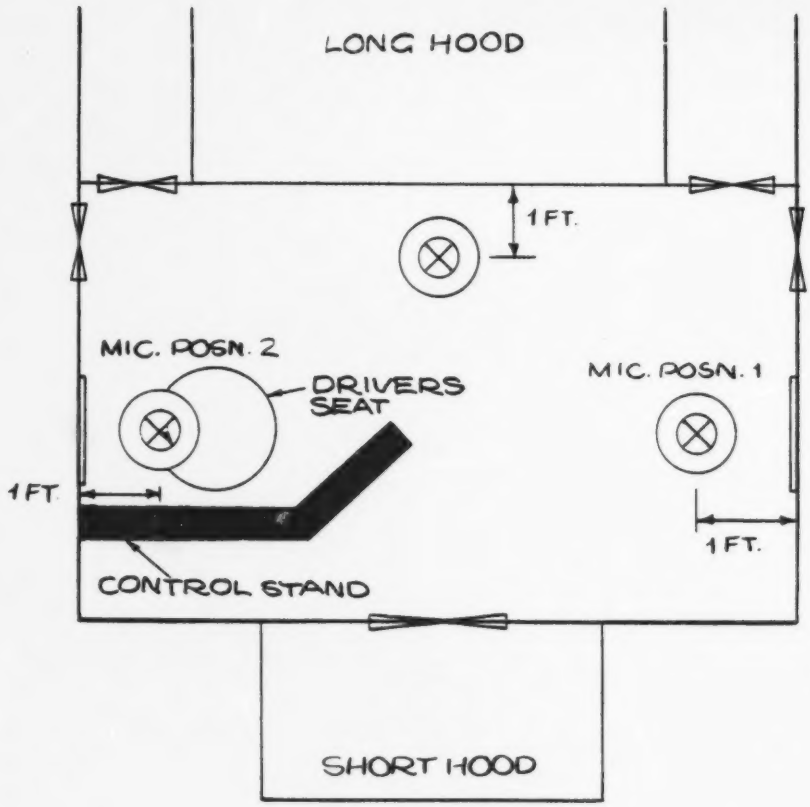
FIG. 31

# M-420 LOCOMOTIVE SOURCE NOISE LEVELS
## (MEASURED AT 3FT. FROM THE SOURCE.)




BOMBARDIER INC;RAIL & DIESEL PRODUCTS DIV;D.SATSANGI;18.FEB.81.

FIG. 32

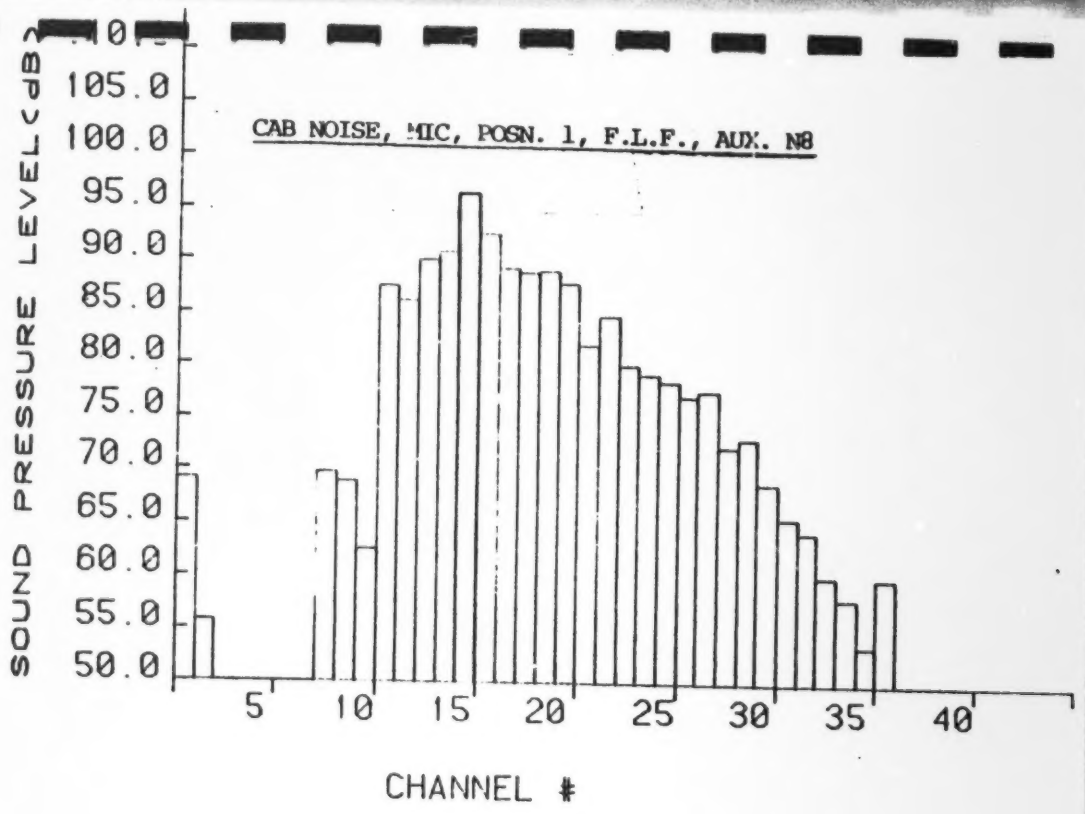



MICROPHONE POSITIONS
FOR CAB NOISE MEASUREMENTS

FIG. 33

| CH. # | FREQ.(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 69.1 |
| 2 | 2.0 | 55.7 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 69.8 |
| 9 | 10.0 | 68.9 |
| 10 | 12.5 | 62.5 |
| 11 | 16.0 | 87.8 |
| 12 | 20.0 | 86.3 |
| 13 | 25.0 | 90.2 |
| 14 | 31.5 | 90.9 |
| 15 | 40.0 | 96.5 |
| 16 | 50.0 | 92.7 |
| 17 | 63.0 | 89.4 |
| 18 | 80.0 | 89.0 |
| 19 | 100.0 | 89.1 |
| 20 | 125.0 | 88.0 |
| 21 | 160.0 | 82.1 |
| 22 | 200.0 | 84.9 |
| 23 | 250.0 | 80.2 |
| 24 | 315.0 | 79.3 |
| 25 | 400.0 | 78.6 |
| 26 | 500.0 | 77.2 |
| 27 | 630.0 | 77.7 |
| 28 | 800.0 | 72.3 |
| 29 | 1000.0 | 73.2 |
| 30 | 1250.0 | 68.8 |
| 31 | 1600.0 | 65.7 |
| 32 | 2000.0 | 64.4 |
| 33 | 2500.0 | 60.2 |
| 34 | 3150.0 | 58.1 |
| 35 | 4000.0 | 53.7 |
| 36 | 5000.0 | 60.1 |
| 37 | 6300.0 | 49.1 |
| 38 | 8000.0 | 49.3 |
| 39 | 10000.0 | 49.5 |
| 40 | 12500.0 | 49.6 |
| 41 | 16000.0 | 49.5 |
| 42 | 20000.0 | 49.3 |

A WEIGHTED LEVEL 83.9dB




Tape#6;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=Full;Aux Load=Full

Hotel Load=Full;78/08/24;0830hr

Mic Ht=4ft;Mic Pos=1ft/Win Op Inst Pan

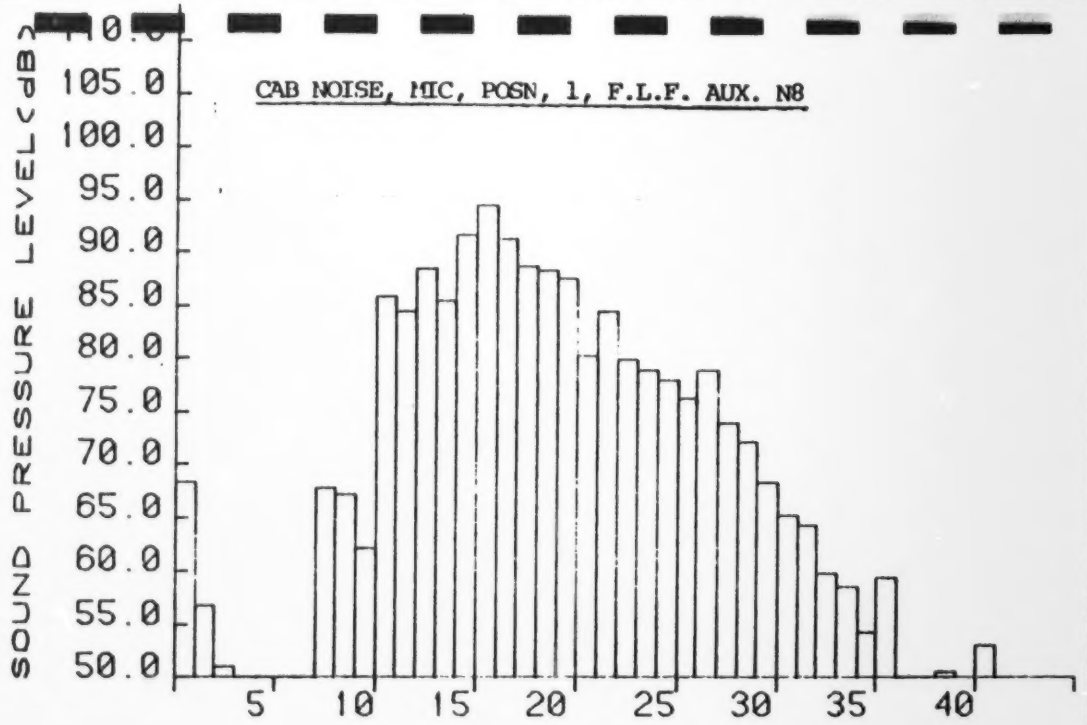
Att:2209=100,Nagra=40

Loco Stat In Sta

FIG. 34

| CH. #. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 68.3 |
| 2 | 2.0 | 56.7 |
| 3 | 2.5 | 51.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 67.8 |
| 9 | 10.0 | 67.1 |
| 10 | 12.5 | 62.1 |
| 11 | 16.0 | 85.9 |
| 12 | 20.0 | 84.4 |
| 13 | 25.0 | 88.5 |
| 14 | 31.5 | 85.5 |
| 15 | 40.0 | 91.8 |
| 16 | 50.0 | 94.5 |
| 17 | 63.0 | 91.4 |
| 18 | 80.0 | 88.8 |
| 19 | 100.0 | 88.3 |
| 20 | 125.0 | 87.6 |
| 21 | 160.0 | 80.3 |
| 22 | 200.0 | 84.5 |
| 23 | 250.0 | 79.9 |
| 24 | 315.0 | 78.8 |
| 25 | 400.0 | 77.9 |
| 26 | 500.0 | 76.2 |
| 27 | 630.0 | 78.8 |
| 28 | 800.0 | 73.9 |
| 29 | 1000.0 | 72.1 |
| 30 | 1250.0 | 68.3 |
| 31 | 1600.0 | 65.2 |
| 32 | 2000.0 | 64.3 |
| 33 | 2500.0 | 59.8 |
| 34 | 3150.0 | 58.6 |
| 35 | 4000.0 | 54.3 |
| 36 | 5000.0 | 59.4 |
| 37 | 6300.0 | 50.1 |
| 38 | 8000.0 | 49.3 |
| 39 | 10000.0 | 50.5 |
| 40 | 12500.0 | 49.6 |
| 41 | 16000.0 | 53.0 |
| 42 | 20000.0 | 49.3 |

A WEIGHTED LEVEL 83.7dB




Tape#6;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=Full;Aux Load=Full

Hotel Load=Full;78/08/24;0830hr

Mic Ht=4ft;Mic Pos= 1ft/Win Op Dr St.

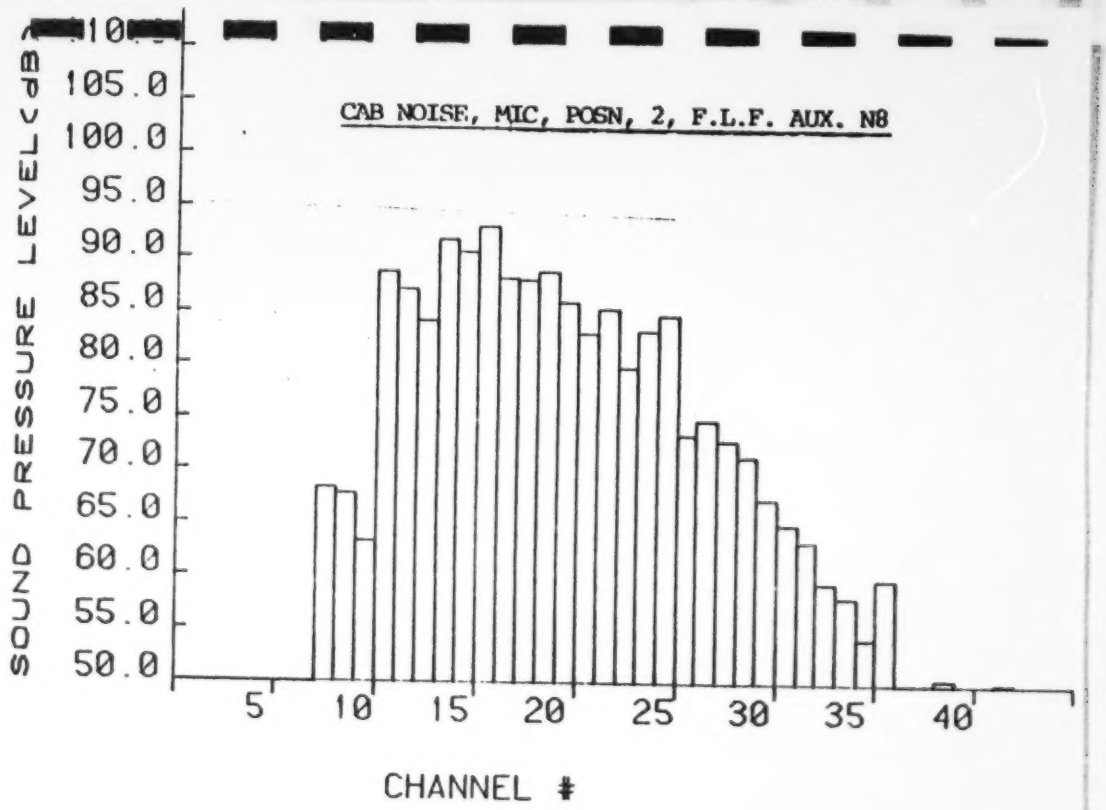
Att:2209=100,Nagra=40

Loco Stat In Sta

FIG. 35

| CH. | FREQ (Hz) | LEVEL (dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 68.3 |
| 9 | 10.0 | 67.8 |
| 10 | 12.5 | 63.3 |
| 11 | 16.0 | 88.9 |
| 12 | 20.0 | 87.3 |
| 13 | 25.0 | 84.3 |
| 14 | 31.5 | 92.0 |
| 15 | 40.0 | 90.9 |
| 16 | 50.0 | 93.3 |
| 17 | 63.0 | 88.3 |
| 18 | 80.0 | 88.3 |
| 19 | 100.0 | 89.0 |
| 20 | 125.0 | 86.2 |
| 21 | 160.0 | 83.1 |
| 22 | 200.0 | 85.6 |
| 23 | 250.0 | 79.9 |
| 24 | 315.0 | 83.4 |
| 25 | 400.0 | 84.8 |
| 26 | 500.0 | 73.5 |
| 27 | 630.0 | 74.9 |
| 28 | 800.0 | 73.0 |
| 29 | 1000.0 | 71.5 |
| 30 | 1250.0 | 67.4 |
| 31 | 1600.0 | 65.0 |
| 32 | 2000.0 | 63.5 |
| 33 | 2500.0 | 59.5 |
| 34 | 3150.0 | 58.2 |
| 35 | 4000.0 | 54.3 |
| 36 | 5000.0 | 59.9 |
| 37 | 6300.0 | 50.1 |
| 38 | 8000.0 | 49.3 |
| 39 | 10000.0 | 50.5 |
| 40 | 12500.0 | 49.6 |
| 41 | 16000.0 | 49.5 |
| 42 | 20000.0 | 50.3 |

A WEIGHTED LEVEL 84.9dB




Tape#6;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=Full;Aux Load=Full

Hotel Load=Full;78/08/24;0830hr

Mic Ht=4ft;Mic Pos=1ft/Dr St

Att:2209=100,Nagra=40

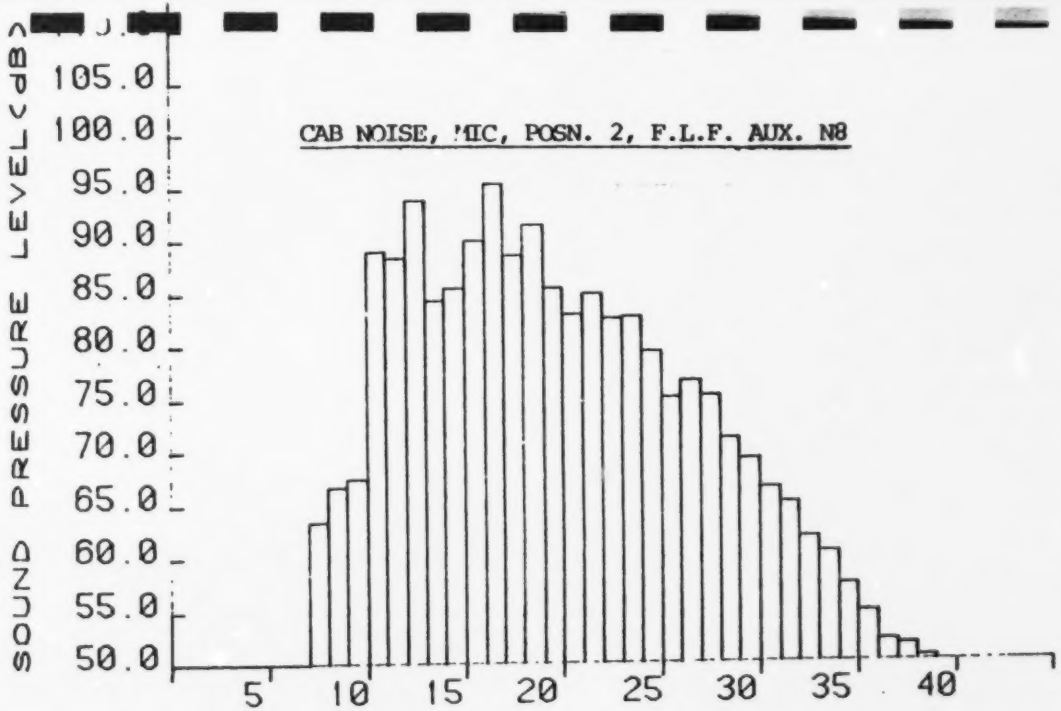
Loco Stat In Sta



FIG. 36

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 63.4 |
| 9 | 10.0 | 66.6 |
| 10 | 12.5 | 67.4 |
| 11 | 16.0 | 89.0 |
| 12 | 20.0 | 88.3 |
| 13 | 25.0 | 93.8 |
| 14 | 31.5 | 84.3 |
| 15 | 40.0 | 85.6 |
| 16 | 50.0 | 90.1 |
| 17 | 63.0 | 95.4 |
| 18 | 80.0 | 88.6 |
| 19 | 100.0 | 91.5 |
| 20 | 125.0 | 85.5 |
| 21 | 160.0 | 83.0 |
| 22 | 200.0 | 85.0 |
| 23 | 250.0 | 82.7 |
| 24 | 315.0 | 82.7 |
| 25 | 400.0 | 79.5 |
| 26 | 500.0 | 75.1 |
| 27 | 630.0 | 76.7 |
| 28 | 800.0 | 75.2 |
| 29 | 1000.0 | 71.2 |
| 30 | 1250.0 | 69.2 |
| 31 | 1600.0 | 66.6 |
| 32 | 2000.0 | 65.1 |
| 33 | 2500.0 | 61.8 |
| 34 | 3150.0 | 60.4 |
| 35 | 4000.0 | 57.5 |
| 36 | 5000.0 | 54.8 |
| 37 | 6300.0 | 52.1 |
| 38 | 8000.0 | 51.7 |
| 39 | 10000.0 | 50.5 |
| 40 | 12500.0 | 49.6 |
| 41 | 16000.0 | 49.5 |
| 42 | 20000.0 | 49.3 |

A WEIGHTED LEVEL 84.5dB




Tape#7;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N8 ;Aux Load=Full

Hotel Load=Full;78/08/24;1030hr

Mic Ht=4ft;Mic Pos=1ft/Dr St

Att:2209=100,Nagra=40

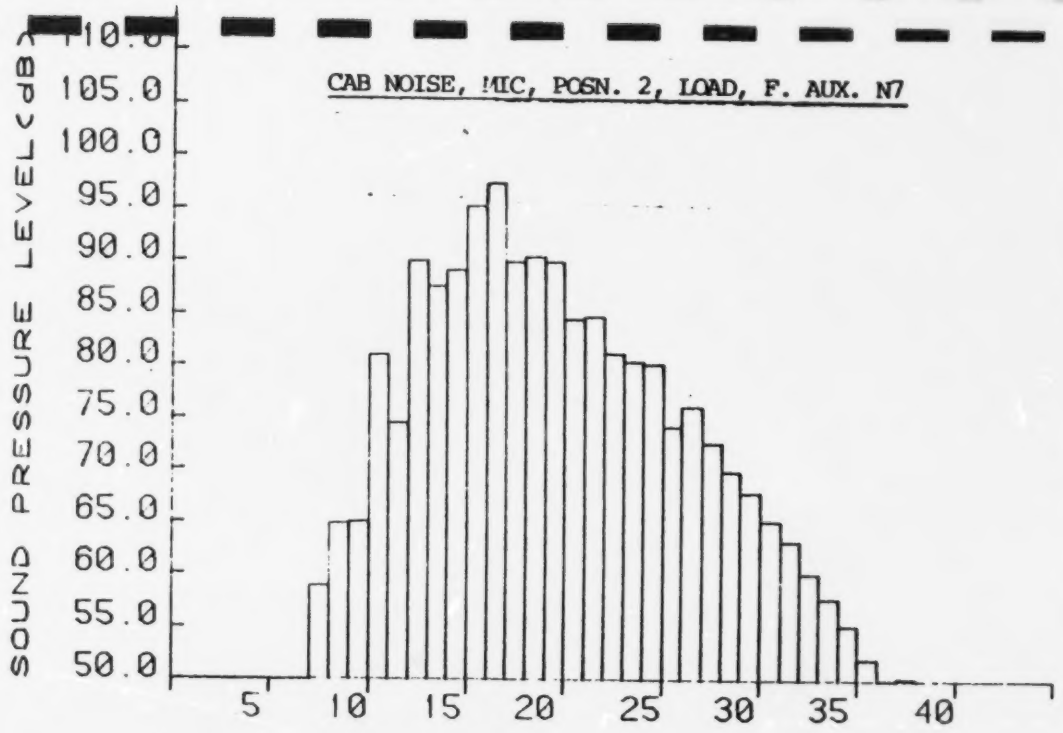
Loco Stat In Sta;Eng Loaded



fig. 37

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 58.9 |
| 9 | 10.0 | 64.8 |
| 10 | 12.5 | 64.9 |
| 11 | 16.0 | 81.1 |
| 12 | 20.0 | 74.4 |
| 13 | 25.0 | 90.1 |
| 14 | 31.5 | 87.6 |
| 15 | 40.0 | 89.2 |
| 16 | 50.0 | 95.3 |
| 17 | 63.0 | 97.5 |
| 18 | 80.0 | 89.9 |
| 19 | 100.0 | 90.4 |
| 20 | 125.0 | 89.9 |
| 21 | 160.0 | 84.4 |
| 22 | 200.0 | 84.7 |
| 23 | 250.0 | 81.3 |
| 24 | 315.0 | 80.4 |
| 25 | 400.0 | 80.1 |
| 26 | 500.0 | 74.2 |
| 27 | 630.0 | 76.1 |
| 28 | 800.0 | 72.6 |
| 29 | 1000.0 | 70.0 |
| 30 | 1250.0 | 67.8 |
| 31 | 1600.0 | 65.1 |
| 32 | 2000.0 | 63.2 |
| 33 | 2500.0 | 60.2 |
| 34 | 3150.0 | 57.9 |
| 35 | 4000.0 | 55.2 |
| 36 | 5000.0 | 52.1 |
| 37 | 6300.0 | 50.1 |
| 38 | 8000.0 | 50.3 |
| 39 | 10000.0 | 49.5 |
| 40 | 12500.0 | 49.6 |
| 41 | 16000.0 | 49.5 |
| 42 | 20000.0 | 49.3 |

A WEIGHTED LEVEL 84.0dB




Tape#7;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N7 ;Aux Load=Full

Hotel Load=Full;78/08/24;1030hr

Mic Ht=4ft;Mic Pos=1ft/Dr St

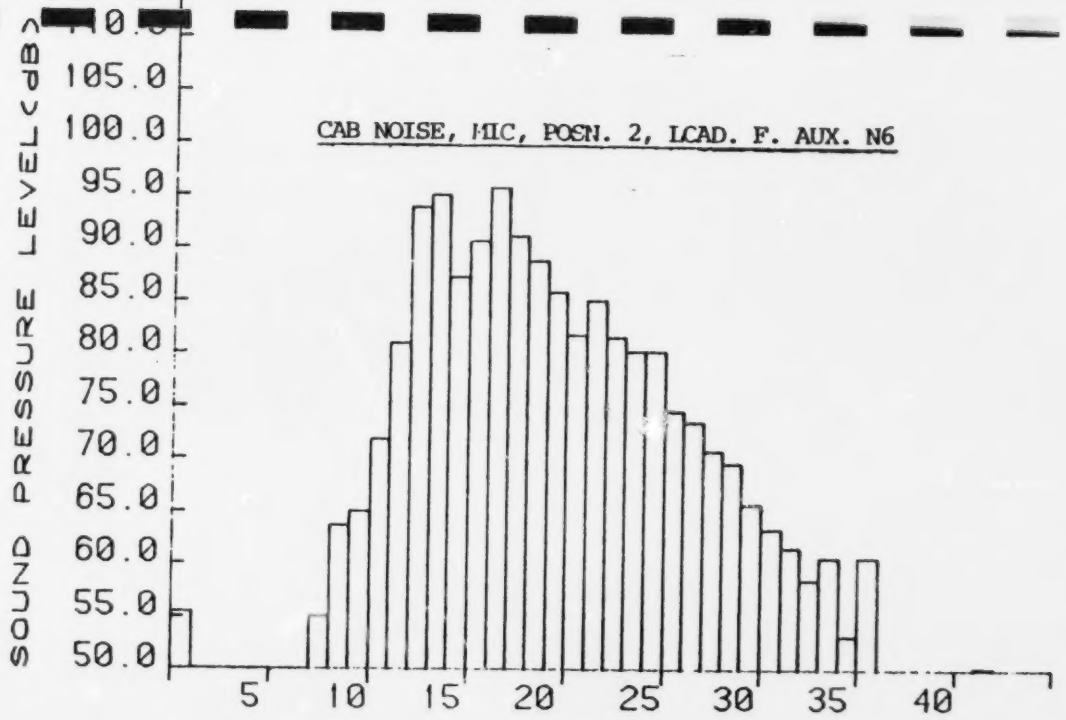
Att:2209=100,Nagra=40

Loco Stat In Sta;Eng Loaded

FIG. 38

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 55.4 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 55.1 |
| 9 | 10.0 | 63.7 |
| 10 | 12.5 | 65.0 |
| 11 | 16.0 | 71.9 |
| 12 | 20.0 | 80.9 |
| 13 | 25.0 | 93.9 |
| 14 | 31.5 | 95.1 |
| 15 | 40.0 | 87.3 |
| 16 | 50.0 | 90.7 |
| 17 | 63.0 | 95.8 |
| 18 | 80.0 | 91.2 |
| 19 | 100.0 | 88.9 |
| 20 | 125.0 | 85.9 |
| 21 | 160.0 | 81.9 |
| 22 | 200.0 | 85.2 |
| 23 | 250.0 | 81.6 |
| 24 | 315.0 | 80.3 |
| 25 | 400.0 | 80.3 |
| 26 | 500.0 | 74.6 |
| 27 | 630.0 | 73.5 |
| 28 | 800.0 | 70.8 |
| 29 | 1000.0 | 69.7 |
| 30 | 1250.0 | 65.7 |
| 31 | 1600.0 | 63.4 |
| 32 | 2000.0 | 61.6 |
| 33 | 2500.0 | 58.6 |
| 34 | 3150.0 | 60.7 |
| 35 | 4000.0 | 53.3 |
| 36 | 5000.0 | 60.7 |
| 37 | 6300.0 | 49.1 |
| 38 | 8000.0 | 49.3 |
| 39 | 10000.0 | 49.5 |
| 40 | 12500.0 | 49.6 |
| 41 | 16000.0 | 49.5 |
| 42 | 20000.0 | 50.3 |

A WEIGHTED LEVEL 83.2dB




Tape#6;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed= N6 ;Aux Load=Full

Hotel Load=Full;78/08/24;1030hr

Mic Ht=4ft;Mic Pos=1ft/Dr St

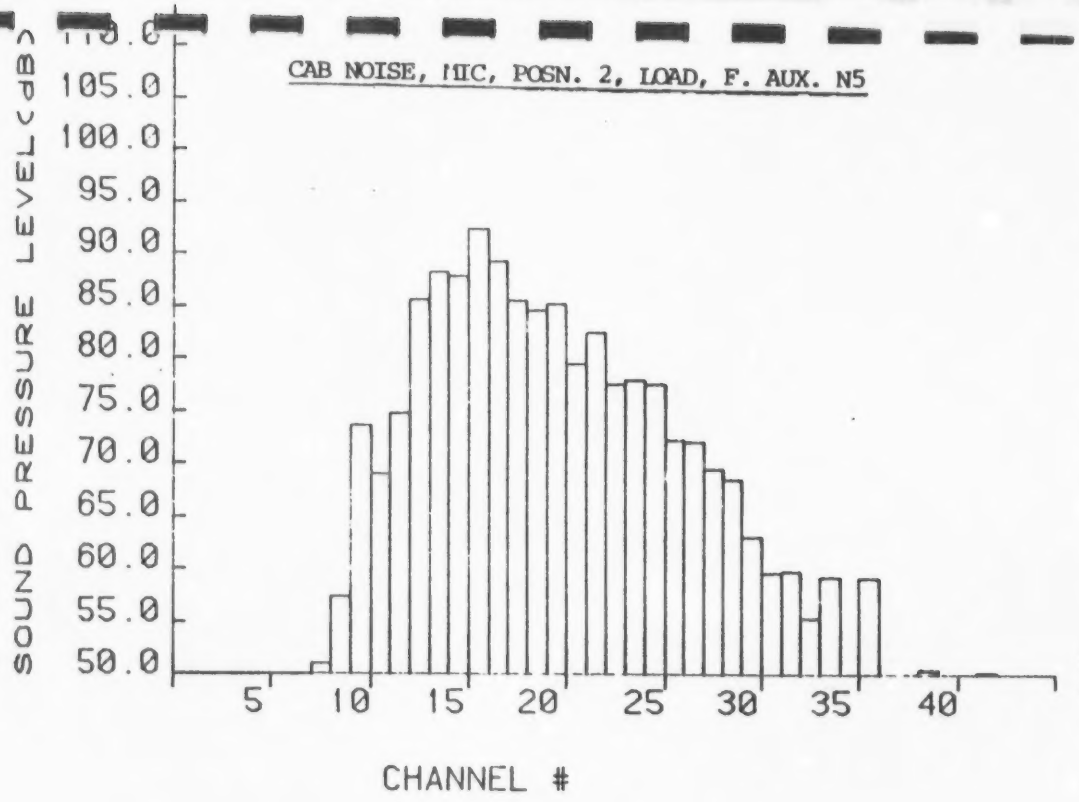
Att:2209=100,Nagra=40

Loco Stat In Sta;Eng Loaded

FIG. 39

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 51.0 |
| 9 | 10.0 | 57.4 |
| 10 | 12.5 | 73.6 |
| 11 | 16.0 | 69.1 |
| 12 | 20.0 | 74.8 |
| 13 | 25.0 | 85.8 |
| 14 | 31.5 | 88.3 |
| 15 | 40.0 | 88.0 |
| 16 | 50.0 | 92.5 |
| 17 | 63.0 | 89.4 |
| 18 | 80.0 | 85.7 |
| 19 | 100.0 | 84.7 |
| 20 | 125.0 | 85.4 |
| 21 | 160.0 | 79.6 |
| 22 | 200.0 | 82.7 |
| 23 | 250.0 | 77.7 |
| 24 | 315.0 | 78.1 |
| 25 | 400.0 | 77.7 |
| 26 | 500.0 | 72.3 |
| 27 | 630.0 | 72.2 |
| 28 | 800.0 | 69.6 |
| 29 | 1000.0 | 68.6 |
| 30 | 1250.0 | 63.1 |
| 31 | 1600.0 | 59.8 |
| 32 | 2000.0 | 59.9 |
| 33 | 2500.0 | 55.4 |
| 34 | 3150.0 | 59.4 |
| 35 | 4000.0 | 49.9 |
| 36 | 5000.0 | 59.3 |
| 37 | 6300.0 | 49.1 |
| 38 | 8000.0 | 49.3 |
| 39 | 10000.0 | 50.5 |
| 40 | 12500.0 | 49.6 |
| 41 | 16000.0 | 49.5 |
| 42 | 20000.0 | 50.3 |

A WEIGHTED LEVEL 80.8dB




Tape#6;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed= N5 ;Aux Load=Full

Hotel Load=Full;78/08/24;1030hr

Mic Ht=4ft;Mic Pos=1ft/Dr St

Att:2209=100,Nagra=40

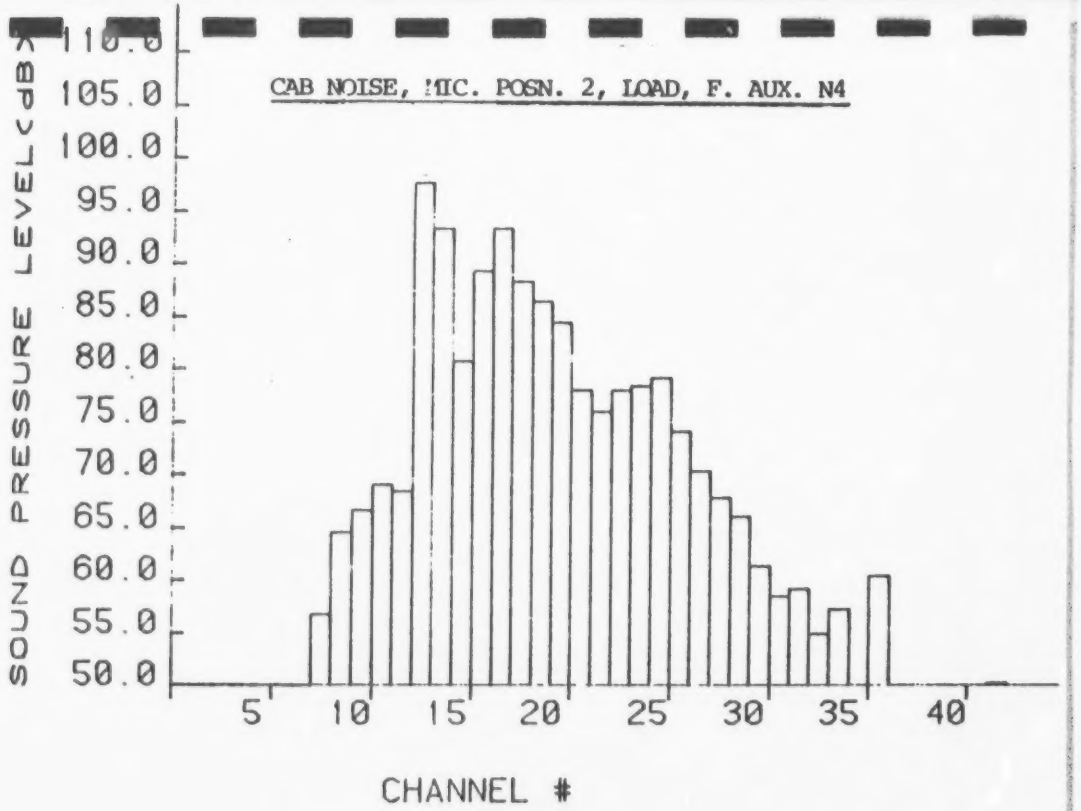
Loco Stat In Sta;Eng Loaded



FIG. 40

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 56.7 |
| 9 | 10.0 | 64.6 |
| 10 | 12.5 | 66.7 |
| 11 | 16.0 | 69.2 |
| 12 | 20.0 | 68.4 |
| 13 | 25.0 | 97.9 |
| 14 | 31.5 | 93.4 |
| 15 | 40.0 | 80.9 |
| 16 | 50.0 | 89.5 |
| 17 | 63.0 | 93.4 |
| 18 | 80.0 | 88.4 |
| 19 | 100.0 | 86.5 |
| 20 | 125.0 | 84.4 |
| 21 | 160.0 | 78.1 |
| 22 | 200.0 | 76.1 |
| 23 | 250.0 | 78.1 |
| 24 | 315.0 | 78.5 |
| 25 | 400.0 | 79.2 |
| 26 | 500.0 | 74.2 |
| 27 | 630.0 | 70.4 |
| 28 | 800.0 | 68.0 |
| 29 | 1000.0 | 66.2 |
| 30 | 1250.0 | 61.5 |
| 31 | 1600.0 | 58.6 |
| 32 | 2000.0 | 59.3 |
| 33 | 2500.0 | 54.9 |
| 34 | 3150.0 | 57.3 |
| 35 | 4000.0 | 49.9 |
| 36 | 5000.0 | 60.6 |
| 37 | 6300.0 | 49.1 |
| 38 | 8000.0 | 49.3 |
| 39 | 10000.0 | 49.5 |
| 40 | 12500.0 | 49.6 |
| 41 | 16000.0 | 49.5 |
| 42 | 20000.0 | 50.3 |

A WEIGHTED LEVEL 80.7dB




Tape#6;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N4 ;Aux Load=Full

Hotel Load=Full;78/08/24;1030hr

Mic Ht=4ft;Mic Pos=1ft/Dr St

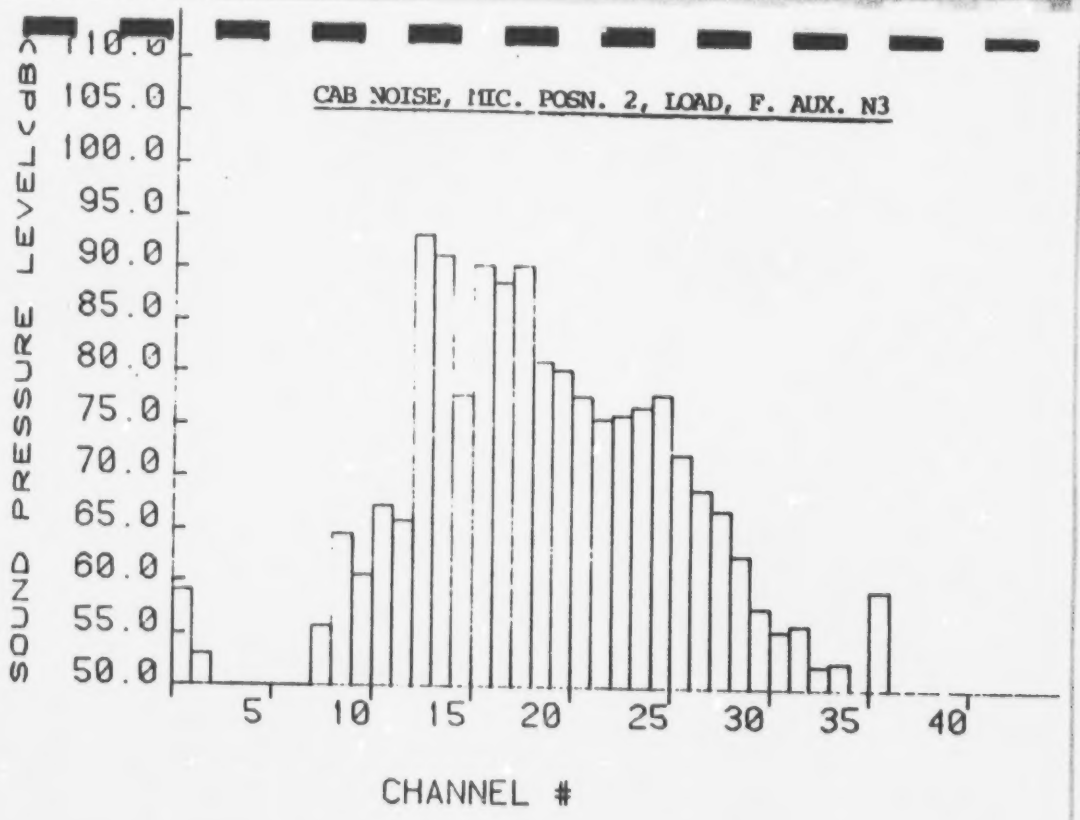
Att:2209=100,Nagra=40

Loco Stat In Sta;Eng Loaded

FIG. 41

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 59.1 |
| 2 | 2.0 | 53.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 55.7 |
| 9 | 10.0 | 64.6 |
| 10 | 12.5 | 60.6 |
| 11 | 16.0 | 67.3 |
| 12 | 20.0 | 65.8 |
| 13 | 25.0 | 93.3 |
| 14 | 31.5 | 91.3 |
| 15 | 40.0 | 78.0 |
| 16 | 50.0 | 90.5 |
| 17 | 63.0 | 88.7 |
| 18 | 80.0 | 90.5 |
| 19 | 100.0 | 81.2 |
| 20 | 125.0 | 80.4 |
| 21 | 160.0 | 78.0 |
| 22 | 200.0 | 75.8 |
| 23 | 250.0 | 76.2 |
| 24 | 315.0 | 76.9 |
| 25 | 400.0 | 78.1 |
| 26 | 500.0 | 72.3 |
| 27 | 630.0 | 69.0 |
| 28 | 800.0 | 67.0 |
| 29 | 1000.0 | 62.8 |
| 30 | 1250.0 | 57.8 |
| 31 | 1600.0 | 55.6 |
| 32 | 2000.0 | 56.1 |
| 33 | 2500.0 | 52.4 |
| 34 | 3150.0 | 52.7 |
| 35 | 4000.0 | 48.9 |
| 36 | 5000.0 | 59.5 |
| 37 | 6300.0 | 49.1 |
| 38 | 8000.0 | 49.3 |
| 39 | 10000.0 | 49.5 |
| 40 | 12500.0 | 49.6 |
| 41 | 16000.0 | 49.5 |
| 42 | 20000.0 | 49.3 |

A WEIGHTED LEVEL 79.0dB




Tape#6;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N3 ;Aux Load=Full

Hotel Load=Full;78/08/24;1030hr

Mic Ht=4ft;Mic Pos=1ft/Dr St

Att:2209=90,Nagra=40

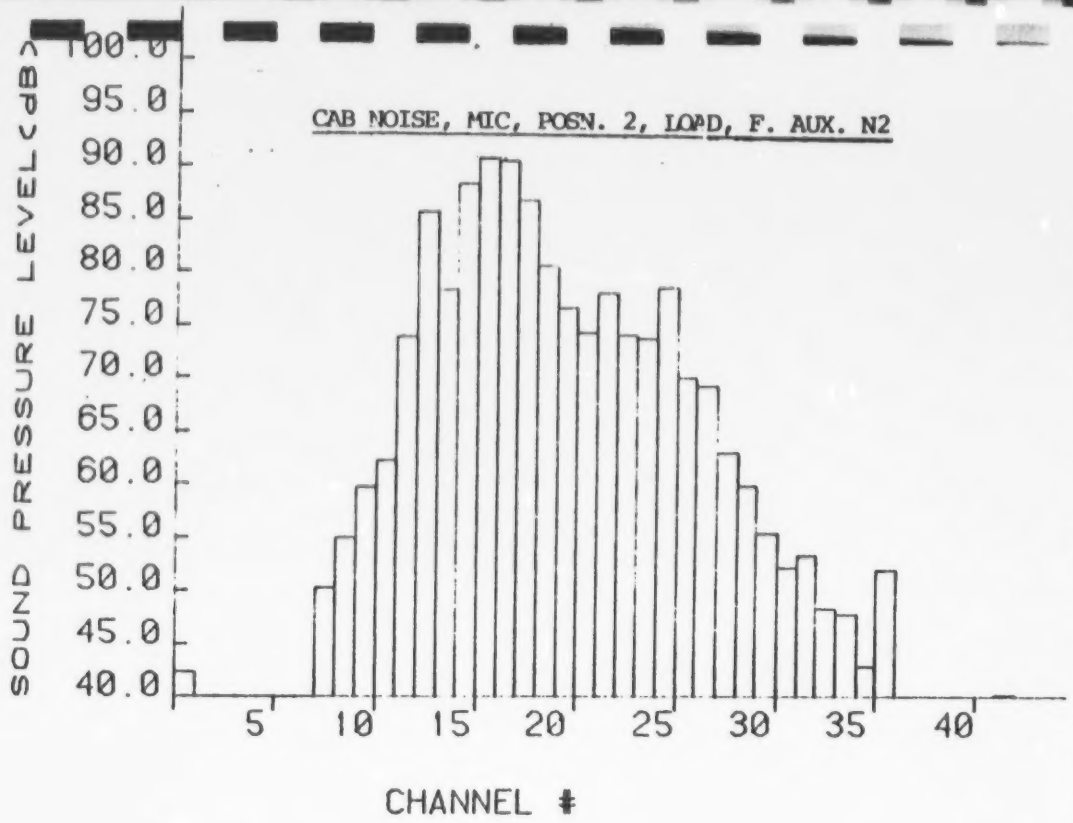
Loco Stat In Sta;Eng Loaded



FIG. 42

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 42.4 |
| 2 | 2.0 | 40.0 |
| 3 | 2.5 | 40.0 |
| 4 | 3.2 | 40.0 |
| 5 | 4.0 | 40.0 |
| 6 | 5.0 | 40.0 |
| 7 | 6.3 | 40.0 |
| 8 | 8.0 | 50.3 |
| 9 | 10.0 | 55.0 |
| 10 | 12.5 | 59.8 |
| 11 | 16.0 | 62.3 |
| 12 | 20.0 | 73.9 |
| 13 | 25.0 | 85.7 |
| 14 | 31.5 | 78.3 |
| 15 | 40.0 | 88.4 |
| 16 | 50.0 | 90.8 |
| 17 | 63.0 | 90.5 |
| 18 | 80.0 | 86.9 |
| 19 | 100.0 | 80.7 |
| 20 | 125.0 | 76.7 |
| 21 | 160.0 | 74.3 |
| 22 | 200.0 | 78.1 |
| 23 | 250.0 | 74.1 |
| 24 | 315.0 | 73.8 |
| 25 | 400.0 | 78.6 |
| 26 | 500.0 | 70.0 |
| 27 | 630.0 | 69.2 |
| 28 | 800.0 | 63.0 |
| 29 | 1000.0 | 60.0 |
| 30 | 1250.0 | 55.5 |
| 31 | 1600.0 | 52.3 |
| 32 | 2000.0 | 53.5 |
| 33 | 2500.0 | 48.3 |
| 34 | 3150.0 | 47.8 |
| 35 | 4000.0 | 42.9 |
| 36 | 5000.0 | 52.0 |
| 37 | 6300.0 | 39.1 |
| 38 | 8000.0 | 39.3 |
| 39 | 10000.0 | 39.5 |
| 40 | 12500.0 | 39.6 |
| 41 | 16000.0 | 39.5 |
| 42 | 20000.0 | 40.3 |

A WEIGHTED LEVEL 78.0dB




Tape#6;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N2 ;Aux Load=Full

Hotel Load=Full;78/08/24;1030hr

Mic Ht=4ft;Mic Pos=1ft/Dr St

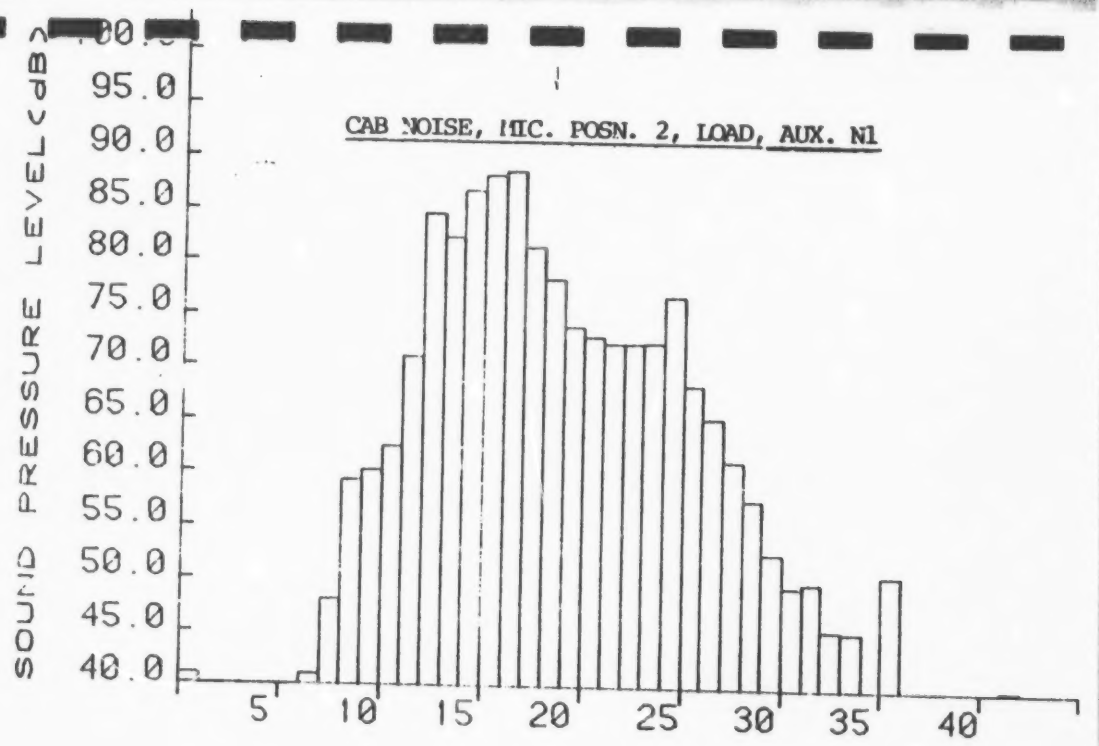
Att:2209=90,Nagra=40

Loco Stat In Sta;Eng Loaded

FIG. 43

| CH. | FREQ (Hz) | LEVEL (dB) |
|---|---|---|
| 1 | 1.6 | 41.0 |
| 2 | 2.0 | 40.0 |
| 3 | 2.5 | 40.0 |
| 4 | 3.2 | 40.0 |
| 5 | 4.0 | 40.0 |
| 6 | 5.0 | 40.0 |
| 7 | 6.3 | 41.0 |
| 8 | 8.0 | 48.1 |
| 9 | 10.0 | 59.4 |
| 10 | 12.5 | 60.3 |
| 11 | 16.0 | 62.6 |
| 12 | 20.0 | 71.1 |
| 13 | 25.0 | 84.7 |
| 14 | 31.5 | 82.5 |
| 15 | 40.0 | 87.0 |
| 16 | 50.0 | 88.4 |
| 17 | 63.0 | 88.8 |
| 18 | 80.0 | 81.6 |
| 19 | 100.0 | 78.6 |
| 20 | 125.0 | 74.1 |
| 21 | 160.0 | 73.1 |
| 22 | 200.0 | 72.5 |
| 23 | 250.0 | 72.5 |
| 24 | 315.0 | 72.6 |
| 25 | 400.0 | 77.0 |
| 26 | 500.0 | 68.6 |
| 27 | 630.0 | 65.5 |
| 28 | 800.0 | 61.5 |
| 29 | 1000.0 | 57.9 |
| 30 | 1250.0 | 52.8 |
| 31 | 1600.0 | 49.7 |
| 32 | 2000.0 | 50.0 |
| 33 | 2500.0 | 45.6 |
| 34 | 3150.0 | 45.5 |
| 35 | 4000.0 | 39.9 |
| 36 | 5000.0 | 50.8 |
| 37 | 6300.0 | 39.1 |
| 38 | 8000.0 | 39.3 |
| 39 | 10000.0 | 39.5 |
| 40 | 12500.0 | 39.6 |
| 41 | 16000.0 | 39.5 |
| 42 | 20000.0 | 40.3 |

A WEIGHTED LEVEL 75.9dB




Tape#6;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N1 ;Aux Load

78/08/24;1030hr

Mic Ht=4ft;Mic Pos=1ft/Dr St

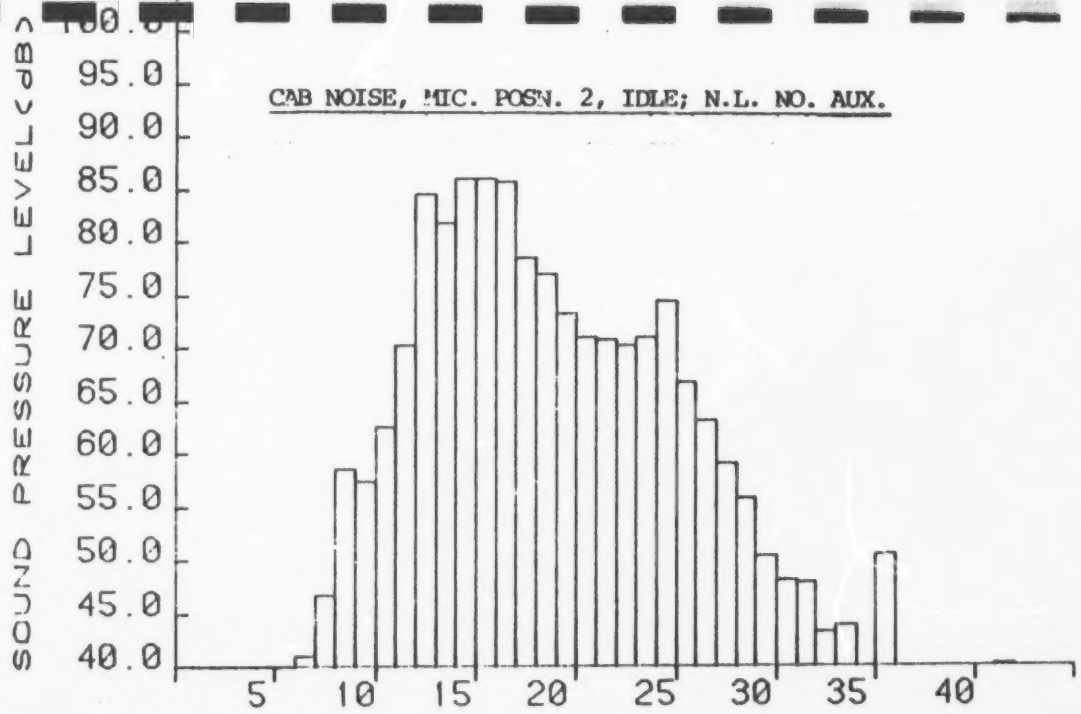
Att:2209=90,Nagra=40

Loco Stat In Sta;Eng Loaded

FIG. 44

| CH. #. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 40.0 |
| 2 | 2.0 | 40.0 |
| 3 | 2.5 | 40.0 |
| 4 | 3.2 | 40.0 |
| 5 | 4.0 | 40.0 |
| 6 | 5.0 | 40.0 |
| 7 | 6.3 | 41.0 |
| 8 | 8.0 | 46.7 |
| 9 | 10.0 | 58.6 |
| 10 | 12.5 | 57.4 |
| 11 | 16.0 | 62.5 |
| 12 | 20.0 | 70.3 |
| 13 | 25.0 | 84.6 |
| 14 | 31.5 | 81.8 |
| 15 | 40.0 | 86.1 |
| 16 | 50.0 | 86.1 |
| 17 | 63.0 | 85.7 |
| 18 | 80.0 | 78.6 |
| 19 | 100.0 | 77.0 |
| 20 | 125.0 | 73.3 |
| 21 | 160.0 | 71.1 |
| 22 | 200.0 | 70.9 |
| 23 | 250.0 | 70.4 |
| 24 | 315.0 | 71.1 |
| 25 | 400.0 | 74.5 |
| 26 | 500.0 | 66.8 |
| 27 | 630.0 | 63.1 |
| 28 | 800.0 | 59.1 |
| 29 | 1000.0 | 55.9 |
| 30 | 1250.0 | 50.4 |
| 31 | 1600.0 | 48.2 |
| 32 | 2000.0 | 48.0 |
| 33 | 2500.0 | 43.3 |
| 34 | 3150.0 | 44.0 |
| 35 | 4000.0 | 38.9 |
| 36 | 5000.0 | 50.6 |
| 37 | 6300.0 | 39.1 |
| 38 | 8000.0 | 39.3 |
| 39 | 10000.0 | 39.5 |
| 40 | 12500.0 | 39.6 |
| 41 | 16000.0 | 39.5 |
| 42 | 20000.0 | 40.3 |

A WEIGHTED LEVEL 73.7dB




Tape#6;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=Idle;

;78/08/24;1030hr

Mic Ht=4ft;Mic Pos=1ft/Dr St

Att:2209=90,Nagra=40

Loco Stat In Sta

FIG. 45

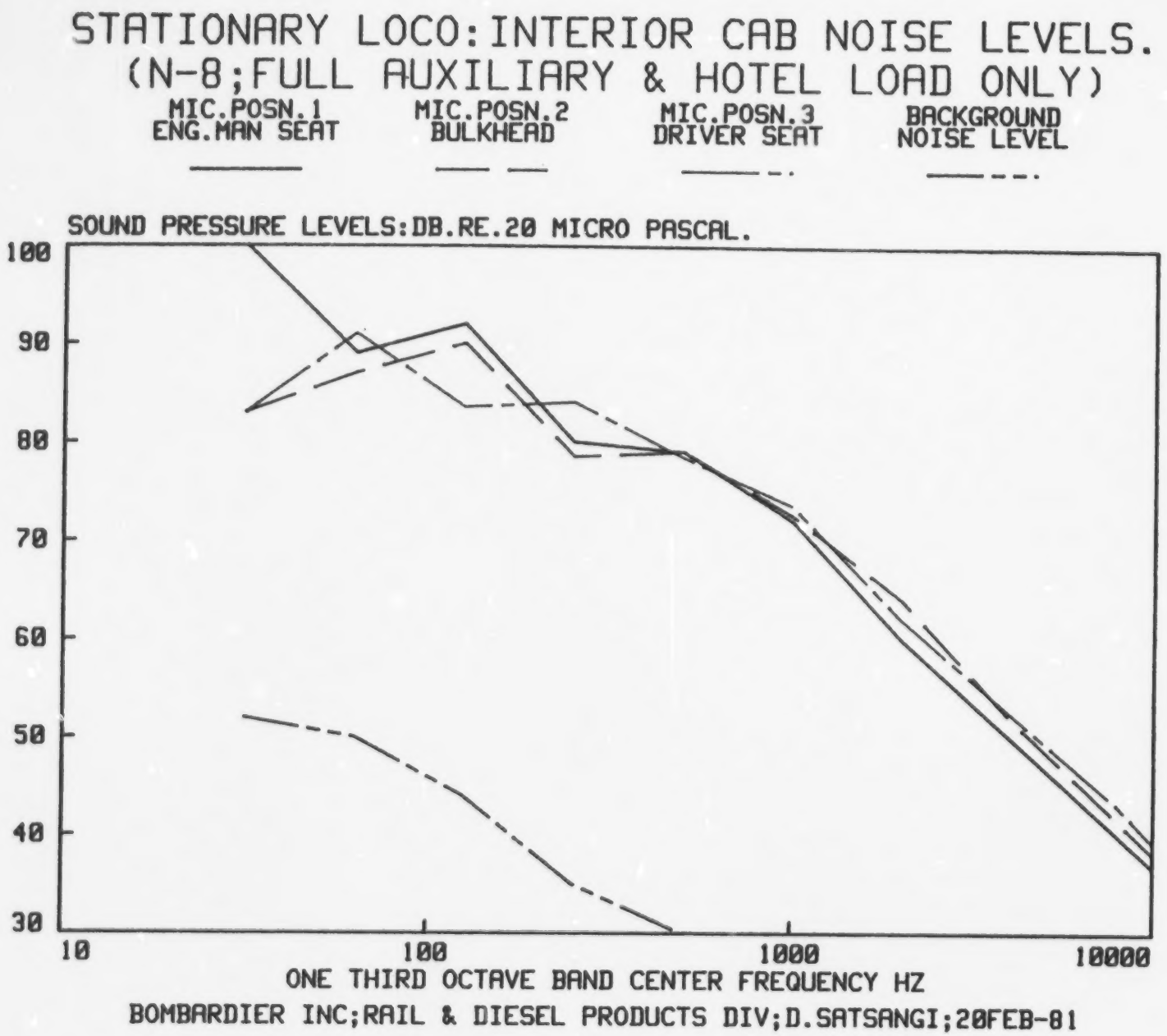
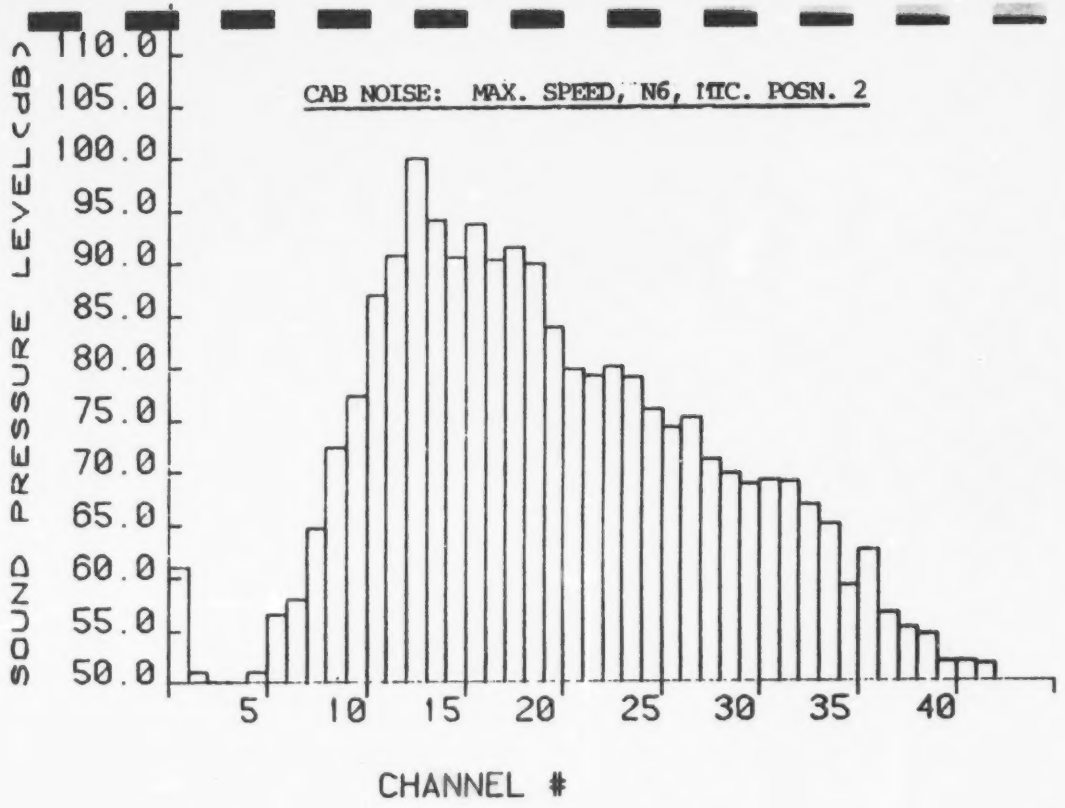

STATIONARY LOCO: INTERIOR CAB NOISE LEVELS.
(N-8; FULL AUXILIARY & HOTEL LOAD ONLY)
MIC.POSN.1 ENG.MAN SEAT
MIC.POSN.2 BULKHEAD
MIC.POSN.3 DRIVER SEAT
BACKGROUND NOISE LEVEL
SOUND PRESSURE LEVELS: DB.RE.20 MICRO PASCAL.
100
90
80
70
60
50
40
30
10
100
1000
10000
ONE THIRD OCTAVE BAND CENTER FREQUENCY HZ
BOMBARDIER INC; RAIL & DIESEL PRODUCTS DIV; D.SATSANGI; 20FEB-81

FIG. 46

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 61.1 |
| 2 | 2.0 | 51.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 51.0 |
| 6 | 5.0 | 58.5 |
| 7 | 6.3 | 57.9 |
| 8 | 8.0 | 64.7 |
| 9 | 10.0 | 72.3 |
| 10 | 12.5 | 77.3 |
| 11 | 16.0 | 87.1 |
| 12 | 20.0 | 90.8 |
| 13 | 25.0 | 100.1 |
| 14 | 31.5 | 94.2 |
| 15 | 40.0 | 90.7 |
| 16 | 50.0 | 93.8 |
| 17 | 63.0 | 90.4 |
| 18 | 80.0 | 91.7 |
| 19 | 100.0 | 90.1 |
| 20 | 125.0 | 83.9 |
| 21 | 160.0 | 79.9 |
| 22 | 200.0 | 79.3 |
| 23 | 250.0 | 80.2 |
| 24 | 315.0 | 79.1 |
| 25 | 400.0 | 76.0 |
| 26 | 500.0 | 74.3 |
| 27 | 630.0 | 75.2 |
| 28 | 800.0 | 71.2 |
| 29 | 1000.0 | 70.0 |
| 30 | 1250.0 | 68.9 |
| 31 | 1600.0 | 69.3 |
| 32 | 2000.0 | 69.2 |
| 33 | 2500.0 | 66.9 |
| 34 | 3150.0 | 65.1 |
| 35 | 4000.0 | 59.3 |
| 36 | 5000.0 | 62.6 |
| 37 | 6300.0 | 56.7 |
| 38 | 8000.0 | 55.3 |
| 39 | 10000.0 | 54.6 |
| 40 | 12500.0 | 52.0 |
| 41 | 16000.0 | 51.9 |
| 42 | 20000.0 | 51.7 |

A WEIGHTED LEVEL 82.8dB




Tape#13;Noise Levels;Avg:Lin 16s

Loco#2534;Eng:N6,65mph;Aux Load=Full

Hotel Load=Full;78/08/26;1400hr

Mic Pos=#2 in Cab

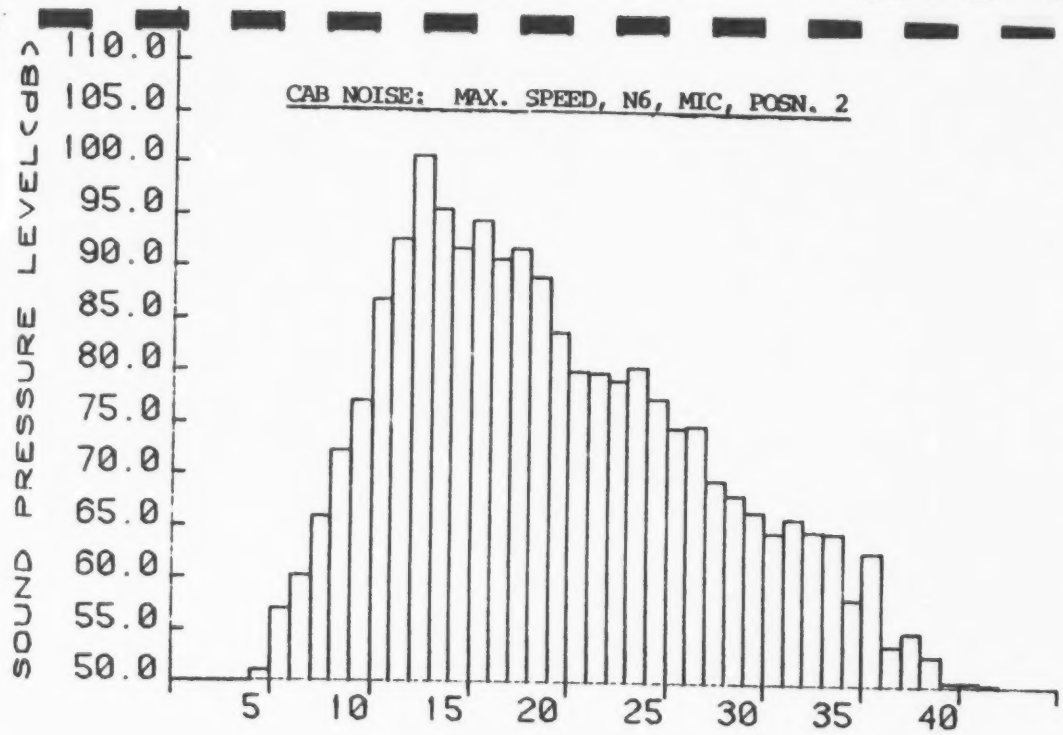
Att:2209=100,Nagra=40;Temp=22 C

Wind=600gt800 fpm from N.

FIG. 47

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 51.0 |
| 6 | 5.0 | 57.0 |
| 7 | 6.3 | 60.1 |
| 8 | 8.0 | 65.9 |
| 9 | 10.0 | 72.2 |
| 10 | 12.5 | 77.1 |
| 11 | 16.0 | 87.0 |
| 12 | 20.0 | 92.8 |
| 13 | 25.0 | 101.0 |
| 14 | 31.5 | 95.7 |
| 15 | 40.0 | 92.1 |
| 16 | 50.0 | 94.8 |
| 17 | 63.0 | 91.0 |
| 18 | 80.0 | 92.1 |
| 19 | 100.0 | 89.2 |
| 20 | 125.0 | 83.9 |
| 21 | 160.0 | 80.1 |
| 22 | 200.0 | 80.1 |
| 23 | 250.0 | 79.3 |
| 24 | 315.0 | 80.5 |
| 25 | 400.0 | 77.5 |
| 26 | 500.0 | 74.7 |
| 27 | 630.0 | 75.0 |
| 28 | 800.0 | 69.6 |
| 29 | 1000.0 | 68.2 |
| 30 | 1250.0 | 66.6 |
| 31 | 1600.0 | 64.8 |
| 32 | 2000.0 | 66.1 |
| 33 | 2500.0 | 64.8 |
| 34 | 3150.0 | 64.7 |
| 35 | 4000.0 | 58.4 |
| 36 | 5000.0 | 62.9 |
| 37 | 6300.0 | 53.9 |
| 38 | 8000.0 | 55.3 |
| 39 | 10000.0 | 53.0 |
| 40 | 12500.0 | 50.6 |
| 41 | 16000.0 | 50.5 |
| 42 | 20000.0 | 50.3 |

A WEIGHTED LEVEL 82.4dB




Tape#13;Noise Levels;Avg:Lin 16s

Loco#2534;Eng:$N_6$,65mph;Aux Load=Full

Hotel Load=Full;78/08/26;1400hr

Mic Pos=#$_2$ in Cab

Att:2209=100,Nagra=40;Temp=22 C

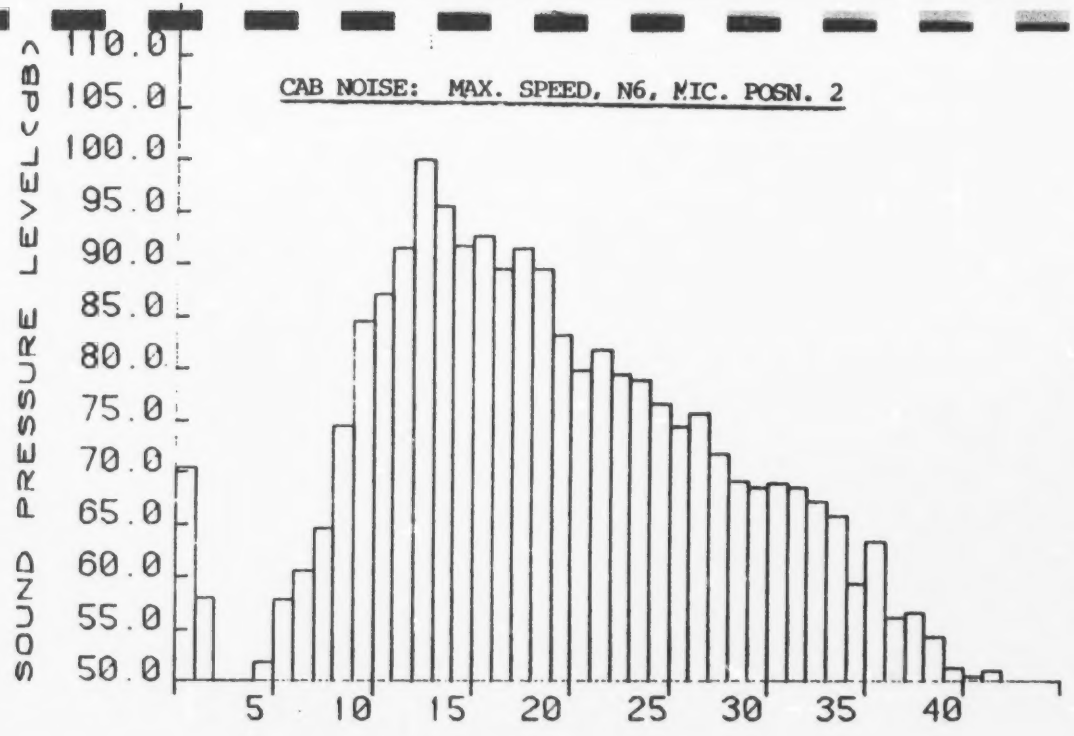
Wind=600gt800 fpm from N.



FIG. 48

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 70.4 |
| 2 | 2.0 | 57.9 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 51.8 |
| 6 | 5.0 | 57.8 |
| 7 | 6.3 | 60.5 |
| 8 | 8.0 | 64.5 |
| 9 | 10.0 | 74.5 |
| 10 | 12.5 | 84.6 |
| 11 | 16.0 | 87.2 |
| 12 | 20.0 | 91.6 |
| 13 | 25.0 | 100.1 |
| 14 | 31.5 | 95.6 |
| 15 | 40.0 | 91.9 |
| 16 | 50.0 | 92.8 |
| 17 | 63.0 | 89.7 |
| 18 | 80.0 | 91.6 |
| 19 | 100.0 | 89.6 |
| 20 | 125.0 | 83.3 |
| 21 | 160.0 | 79.9 |
| 22 | 200.0 | 81.9 |
| 23 | 250.0 | 79.6 |
| 24 | 315.0 | 79.0 |
| 25 | 400.0 | 76.7 |
| 26 | 500.0 | 74.4 |
| 27 | 630.0 | 75.7 |
| 28 | 800.0 | 71.9 |
| 29 | 1000.0 | 69.3 |
| 30 | 1250.0 | 68.6 |
| 31 | 1600.0 | 69.0 |
| 32 | 2000.0 | 68.6 |
| 33 | 2500.0 | 67.3 |
| 34 | 3150.0 | 65.9 |
| 35 | 4000.0 | 59.4 |
| 36 | 5000.0 | 63.5 |
| 37 | 6300.0 | 56.1 |
| 38 | 8000.0 | 56.7 |
| 39 | 10000.0 | 54.3 |
| 40 | 12500.0 | 51.4 |
| 41 | 16000.0 | 50.5 |
| 42 | 20000.0 | 51.1 |

A WEIGHTED LEVEL 82.9dB




Tape#13;Noise Levels;Avg:Lin 16s

Loco#2534;Eng:N6,65mph;Aux Load=Full

Hotel Load=Full;78/08/26;1400hr

Mic Pos=#2 in Cab

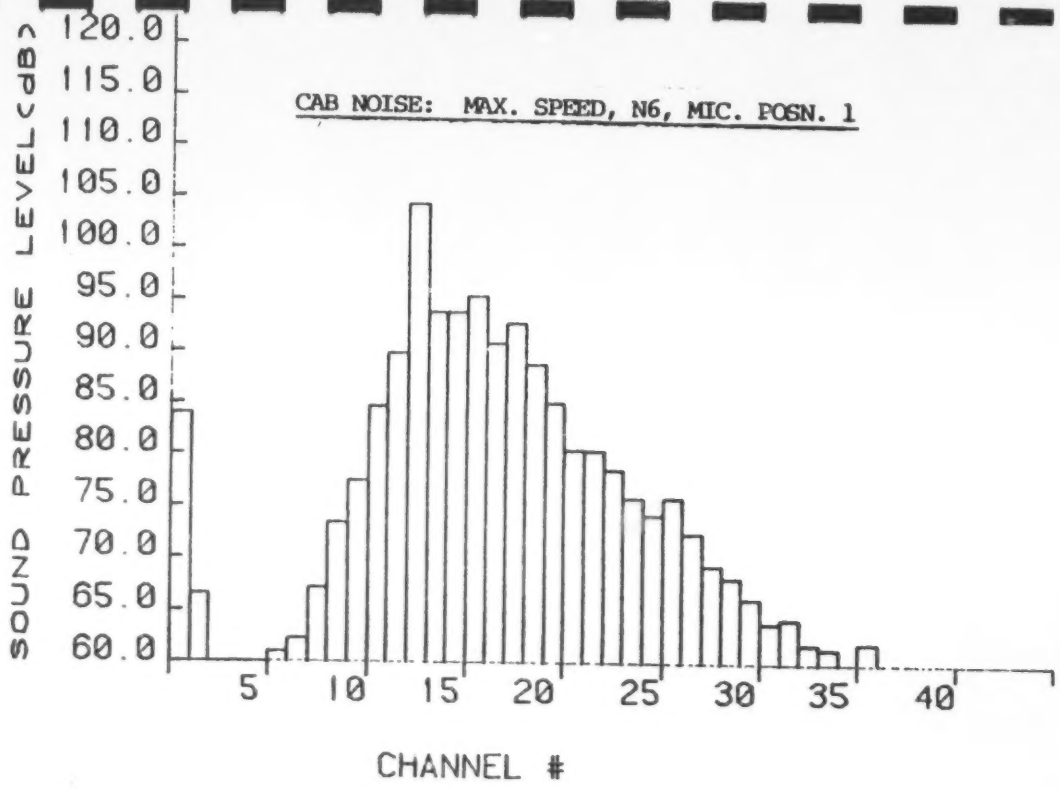
Att:2209=100,Nagra=40;Temp=22 C

Wind=600gt800 fpm from N.

FIG. 49

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 83.9 |
| 2 | 2.0 | 66.5 |
| 3 | 2.5 | 60.0 |
| 4 | 3.2 | 60.0 |
| 5 | 4.0 | 60.0 |
| 6 | 5.0 | 61.0 |
| 7 | 6.3 | 62.4 |
| 8 | 8.0 | 67.2 |
| 9 | 10.0 | 73.4 |
| 10 | 12.5 | 77.4 |
| 11 | 16.0 | 84.8 |
| 12 | 20.0 | 89.9 |
| 13 | 25.0 | 104.5 |
| 14 | 31.5 | 93.9 |
| 15 | 40.0 | 94.0 |
| 16 | 50.0 | 95.5 |
| 17 | 63.0 | 91.0 |
| 18 | 80.0 | 93.0 |
| 19 | 100.0 | 88.8 |
| 20 | 125.0 | 85.1 |
| 21 | 160.0 | 80.5 |
| 22 | 200.0 | 80.5 |
| 23 | 250.0 | 78.7 |
| 24 | 315.0 | 75.8 |
| 25 | 400.0 | 74.2 |
| 26 | 500.0 | 75.8 |
| 27 | 630.0 | 72.5 |
| 28 | 800.0 | 69.4 |
| 29 | 1000.0 | 68.3 |
| 30 | 1250.0 | 66.3 |
| 31 | 1600.0 | 64.0 |
| 32 | 2000.0 | 64.4 |
| 33 | 2500.0 | 61.9 |
| 34 | 3150.0 | 61.6 |
| 35 | 4000.0 | 58.9 |
| 36 | 5000.0 | 62.1 |
| 37 | 6300.0 | 59.1 |
| 38 | 8000.0 | 59.3 |
| 39 | 10000.0 | 59.5 |
| 40 | 12500.0 | 59.6 |
| 41 | 16000.0 | 59.5 |
| 42 | 20000.0 | 59.3 |

A WEIGHTED LEVEL 81.5dB




Tape#12;Noise Levels;Avg:Lin 16s

Loco#2534;Eng:N6,65mph;Aux Load=Full

Hotel Load=Full;78/08/26;1400hr

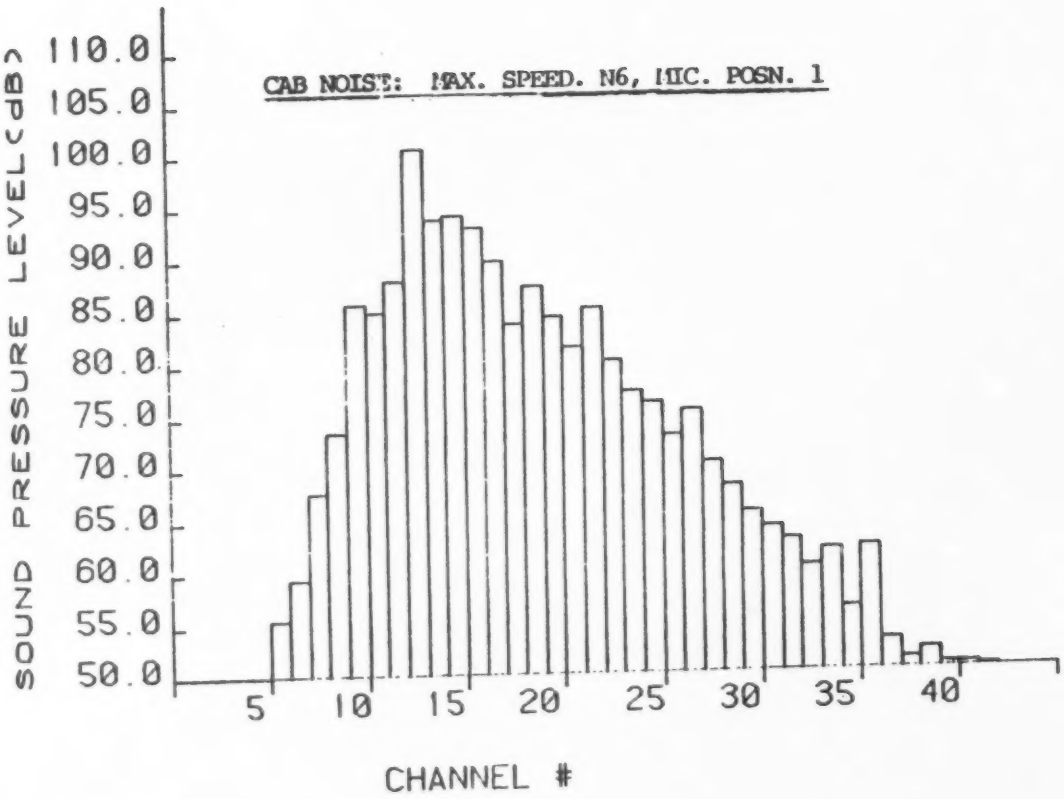
Mic Ht=4ft;Mic Pos=1ft/Win Op Inst Pan

Att:2209=100,Nagra=40;Temp=22 C

Wind=600gt800 fpm from N.

FIG. 50

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 55.4 |
| 7 | 6.3 | 59.4 |
| 8 | 8.0 | 67.7 |
| 9 | 10.0 | 73.4 |
| 10 | 12.5 | 85.7 |
| 11 | 16.0 | 85.0 |
| 12 | 20.0 | 87.9 |
| 13 | 25.0 | 100.7 |
| 14 | 31.5 | 93.8 |
| 15 | 40.0 | 94.2 |
| 16 | 50.0 | 93.1 |
| 17 | 63.0 | 89.8 |
| 18 | 80.0 | 83.8 |
| 19 | 100.0 | 87.3 |
| 20 | 125.0 | 84.4 |
| 21 | 160.0 | 81.4 |
| 22 | 200.0 | 85.3 |
| 23 | 250.0 | 80.2 |
| 24 | 315.0 | 77.2 |
| 25 | 400.0 | 76.0 |
| 26 | 500.0 | 72.9 |
| 27 | 630.0 | 75.2 |
| 28 | 800.0 | 70.3 |
| 29 | 1000.0 | 68.0 |
| 30 | 1250.0 | 65.5 |
| 31 | 1600.0 | 63.9 |
| 32 | 2000.0 | 62.8 |
| 33 | 2500.0 | 60.2 |
| 34 | 3150.0 | 61.7 |
| 35 | 4000.0 | 56.1 |
| 36 | 5000.0 | 62.0 |
| 37 | 6300.0 | 53.1 |
| 38 | 8000.0 | 51.1 |
| 39 | 10000.0 | 51.9 |
| 40 | 12500.0 | 50.6 |
| 41 | 16000.0 | 50.5 |




Tape#12;Noise Levels;Avg:Lin 16s

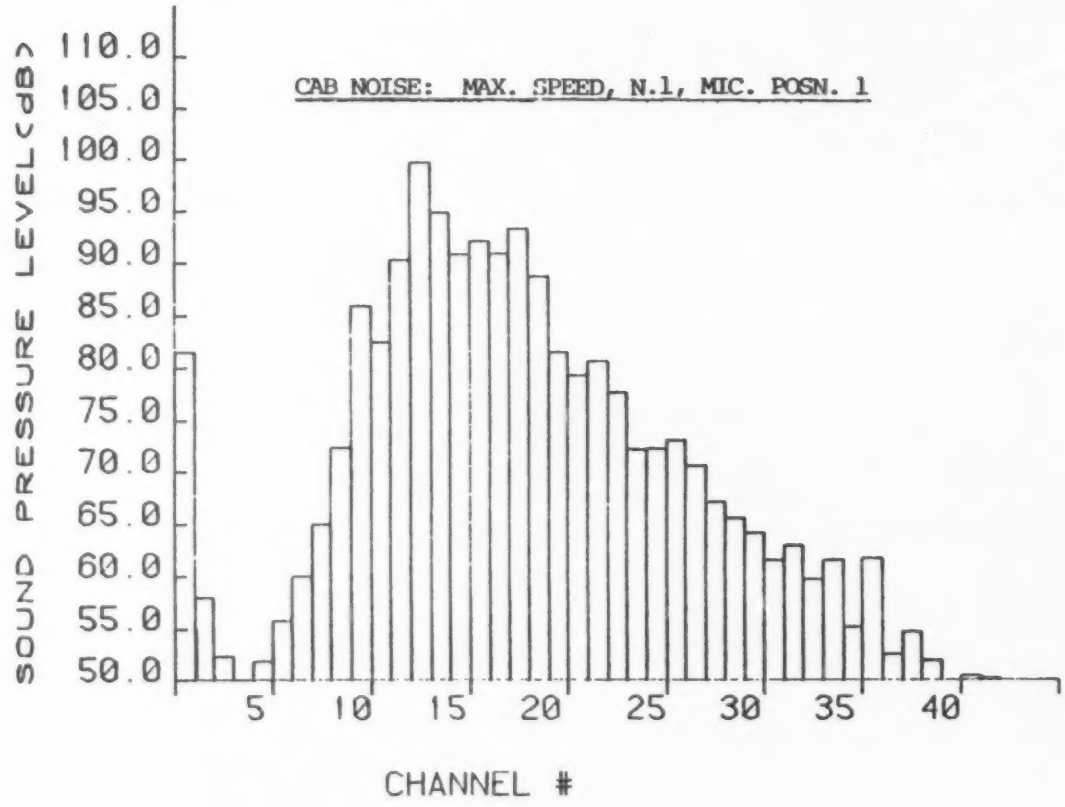
Loco#2534;Eng:N6,65mph;Aux Load=Full

Hotel Load=Full;78/08/26;1400hr

Mic Ht=4ft;Mic Pos=1ft/Win Op Dr St

Att:2209=100,Nagra=40;Temp=22 C

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 81.4 |
| 2 | 2.0 | 57.9 |
| 3 | 2.5 | 52.4 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 51.8 |
| 6 | 5.0 | 55.7 |
| 7 | 6.3 | 60.0 |
| 8 | 8.0 | 64.9 |
| 9 | 10.0 | 72.4 |
| 10 | 12.5 | 86.0 |
| 11 | 16.0 | 82.5 |
| 12 | 20.0 | 90.4 |
| 13 | 25.0 | 99.8 |
| 14 | 31.5 | 95.0 |
| 15 | 40.0 | 91.0 |
| 16 | 50.0 | 92.3 |
| 17 | 63.0 | 91.1 |
| 18 | 80.0 | 93.5 |
| 19 | 100.0 | 88.9 |
| 20 | 125.0 | 81.6 |
| 21 | 160.0 | 79.4 |
| 22 | 200.0 | 80.7 |
| 23 | 250.0 | 77.8 |
| 24 | 315.0 | 72.2 |
| 25 | 400.0 | 72.4 |
| 26 | 500.0 | 73.2 |
| 27 | 630.0 | 70.7 |
| 28 | 800.0 | 67.2 |
| 29 | 1000.0 | 65.6 |
| 30 | 1250.0 | 64.2 |
| 31 | 1600.0 | 61.6 |
| 32 | 2000.0 | 63.1 |
| 33 | 2500.0 | 59.8 |
| 34 | 3150.0 | 61.6 |
| 35 | 4000.0 | 55.2 |
| 36 | 5000.0 | 61.7 |
| 37 | 6300.0 | 52.6 |
| 38 | 8000.0 | 54.7 |
| 39 | 10000.0 | 51.9 |
| 40 | 12500.0 | 49.6 |
| 41 | 16000.0 | 50.5 |




Tape#12;Noise Levels;Avg:Lin 16s

Loco#2534;Eng:N.1,65mph;Aux Load

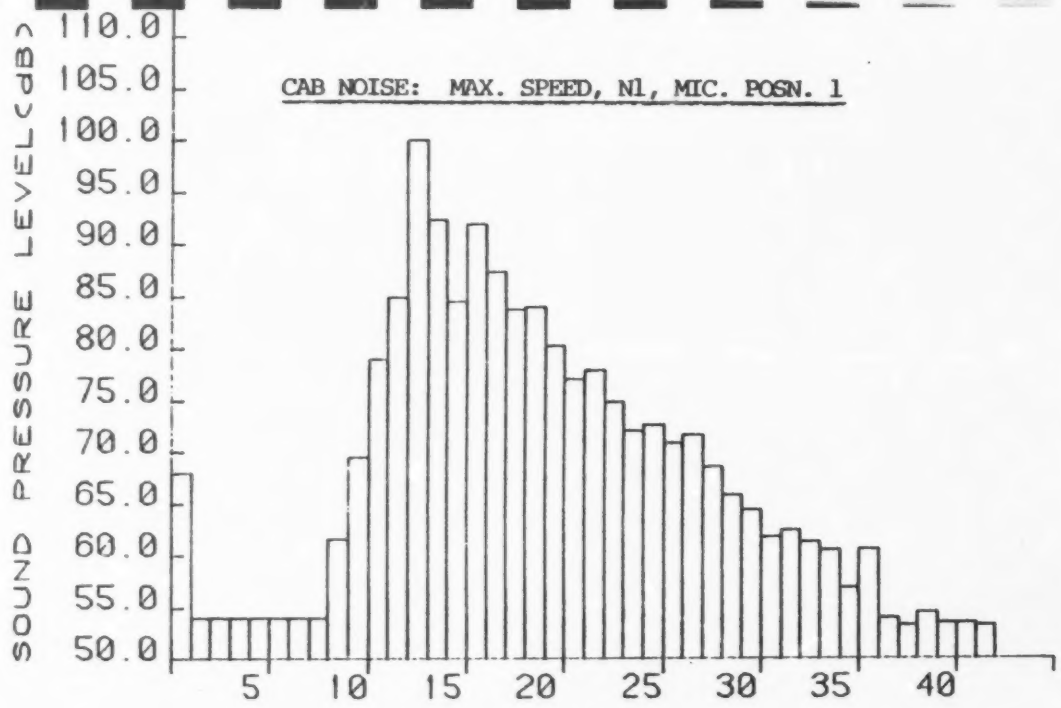
Hotel Load=Full;78/08/26;1400hr

Mic Ht=4ft;Mic Pos=1ft/Win Op Inst Pan

Att:2209=100,Nagra=40;Temp=22 C

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 67.9 |
| 2 | 2.0 | 54.0 |
| 3 | 2.5 | 54.0 |
| 4 | 3.2 | 54.0 |
| 5 | 4.0 | 54.0 |
| 6 | 5.0 | 54.0 |
| 7 | 6.3 | 54.0 |
| 8 | 8.0 | 54.0 |
| 9 | 10.0 | 61.6 |
| 10 | 12.5 | 69.5 |
| 11 | 16.0 | 79.1 |
| 12 | 20.0 | 85.0 |
| 13 | 25.0 | 100.0 |
| 14 | 31.5 | 92.4 |
| 15 | 40.0 | 84.6 |
| 16 | 50.0 | 92.1 |
| 17 | 63.0 | 87.5 |
| 18 | 80.0 | 83.8 |
| 19 | 100.0 | 84.1 |
| 20 | 125.0 | 80.3 |
| 21 | 160.0 | 77.1 |
| 22 | 200.0 | 78.0 |
| 23 | 250.0 | 74.9 |
| 24 | 315.0 | 72.1 |
| 25 | 400.0 | 72.6 |
| 26 | 500.0 | 70.9 |
| 27 | 630.0 | 71.7 |
| 28 | 800.0 | 68.6 |
| 29 | 1000.0 | 65.9 |
| 30 | 1250.0 | 64.4 |
| 31 | 1600.0 | 61.9 |
| 32 | 2000.0 | 62.5 |
| 33 | 2500.0 | 61.3 |
| 34 | 3150.0 | 60.6 |
| 35 | 4000.0 | 56.9 |
| 36 | 5000.0 | 60.7 |
| 37 | 6300.0 | 54.1 |
| 38 | 8000.0 | 53.3 |
| 39 | 10000.0 | 54.5 |
| 40 | 12500.0 | 53.6 |
| 41 | 16000.0 | 53.5 |
| 42 | 20000.0 | 53.3 |

A WEIGHTED LEVEL 78.5dB




Tape#12;Noise Levels;Avg:Lin 16s

Loco#2534;Eng:N1,65mph;Aux Load

Hotel Load=Full;78/08/26;1400hr

Mic Ht=4ft;Mic Pos=1ft/Win Op Dr St

Att:2209=90,Nagra=44;Temp=22 C

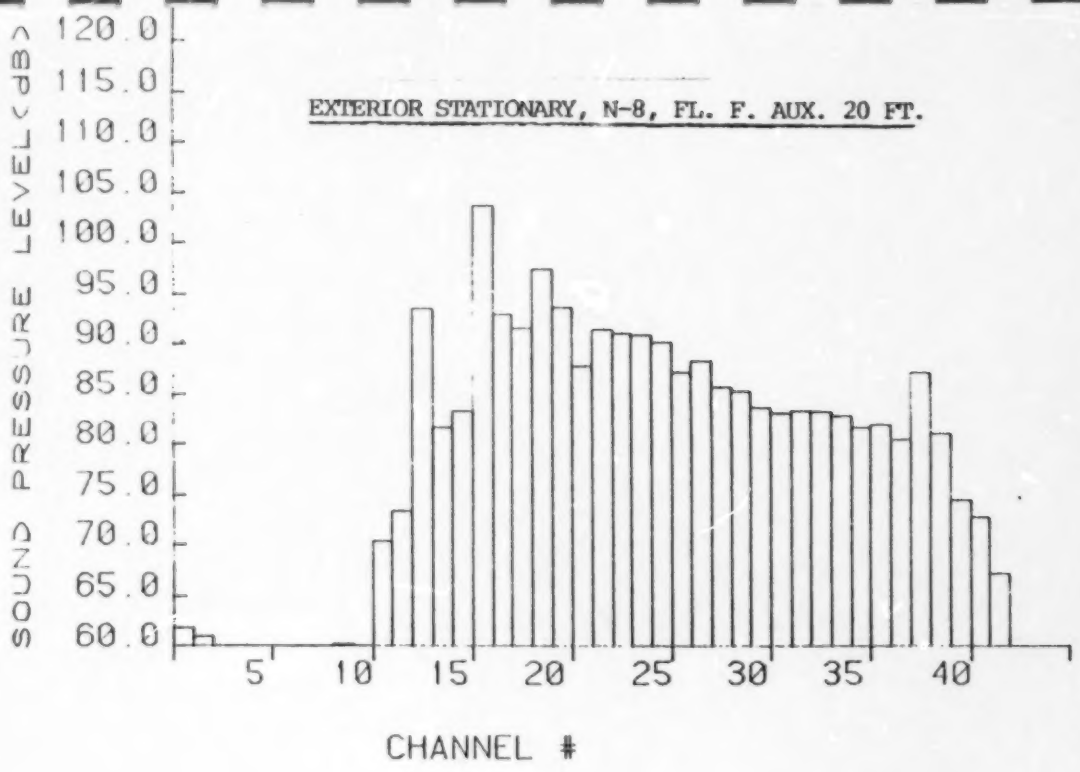
Wind=600gt800 fpm from N.

NOTCH SETTING BACKED OFF TO #1 AFTER HITTING 65 MPH

FIG. 53

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 61.8 |
| 2 | 2.0 | 61.0 |
| 3 | 2.5 | 60.0 |
| 4 | 3.2 | 60.0 |
| 5 | 4.0 | 60.0 |
| 6 | 5.0 | 60.0 |
| 7 | 6.3 | 60.0 |
| 8 | 8.0 | 60.0 |
| 9 | 10.0 | 60.2 |
| 10 | 12.5 | 60.0 |
| 11 | 16.0 | 70.4 |
| 12 | 20.0 | 73.4 |
| 13 | 25.0 | 93.5 |
| 14 | 31.5 | 81.7 |
| 15 | 40.0 | 83.5 |
| 16 | 50.0 | 103.8 |
| 17 | 63.0 | 93.0 |
| 18 | 80.0 | 91.6 |
| 19 | 100.0 | 97.5 |
| 20 | 125.0 | 93.7 |
| 21 | 160.0 | 87.8 |
| 22 | 200.0 | 91.5 |
| 23 | 250.0 | 91.1 |
| 24 | 315.0 | 91.0 |
| 25 | 400.0 | 90.2 |
| 26 | 500.0 | 87.2 |
| 27 | 630.0 | 88.4 |
| 28 | 800.0 | 85.8 |
| 29 | 1000.0 | 85.4 |
| 30 | 1250.0 | 83.6 |
| 31 | 1600.0 | 83.2 |
| 32 | 2000.0 | 83.4 |
| 33 | 2500.0 | 83.3 |
| 34 | 3150.0 | 82.9 |
| 35 | 4000.0 | 81.7 |
| 36 | 5000.0 | 82.0 |
| 37 | 6300.0 | 80.6 |
| 38 | 8000.0 | 87.2 |
| 39 | 10000.0 | 81.0 |
| 40 | 12500.0 | 74.5 |
| 41 | 16000.0 | 72.8 |
| 42 | 20000.0 | 67.1 |

A WEIGHTED LEVEL 96.8dB




Tape#2;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed= N8 ;Aux Load=Full

Turbo In.Cone Rem ;78/08/16;0900hr

Mic Ht=4ft;Mic Pos= 20ft/RHS

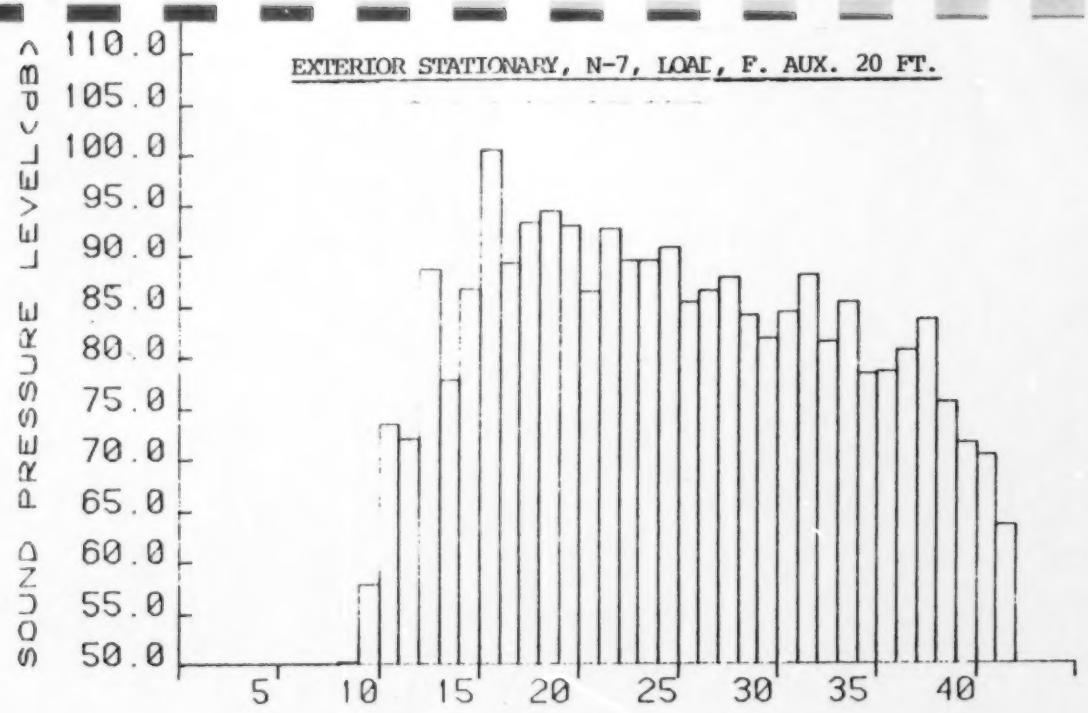
Att:2209=100,Nagra=40;Temp=27 C

Wind=400gt600 fpm from N.

FIG. 54

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 50.0 |
| 9 | 10.0 | 50.2 |
| 10 | 12.5 | 57.8 |
| 11 | 16.0 | 73.6 |
| 12 | 20.0 | 72.1 |
| 13 | 25.0 | 88.7 |
| 14 | 31.5 | 77.8 |
| 15 | 40.0 | 86.9 |
| 16 | 50.0 | 100.8 |
| 17 | 63.0 | 89.4 |
| 18 | 80.0 | 93.5 |
| 19 | 100.0 | 94.6 |
| 20 | 125.0 | 93.1 |
| 21 | 160.0 | 86.5 |
| 22 | 200.0 | 92.8 |
| 23 | 250.0 | 89.7 |
| 24 | 315.0 | 89.6 |
| 25 | 400.0 | 91.0 |
| 26 | 500.0 | 85.5 |
| 27 | 630.0 | 86.6 |
| 28 | 800.0 | 87.9 |
| 29 | 1000.0 | 84.3 |
| 30 | 1250.0 | 82.0 |
| 31 | 1600.0 | 84.6 |
| 32 | 2000.0 | 88.3 |
| 33 | 2500.0 | 81.6 |
| 34 | 3150.0 | 85.5 |
| 35 | 4000.0 | 78.5 |
| 36 | 5000.0 | 78.8 |
| 37 | 6300.0 | 80.8 |
| 38 | 8000.0 | 83.8 |
| 39 | 10000.0 | 75.8 |
| 40 | 12500.0 | 71.7 |
| 41 | 16000.0 | 70.6 |
| 42 | 20000.0 | 63.7 |

A WEIGHTED LEVEL 96.9dB




Tape#2;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed= N7 ;Aux Load=Full

Turbo In. Cone Rem;78/08/16;0900hr

Mic Ht=4ft;Mic Pos= 20ft/RHS

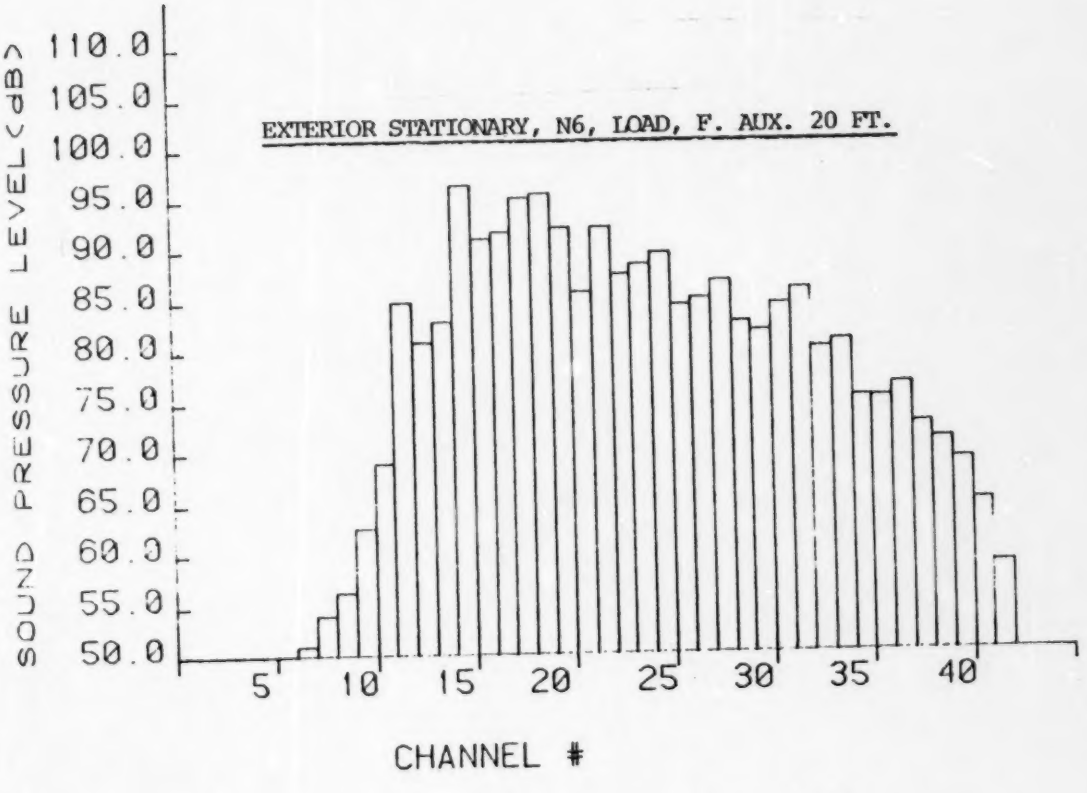
Att:2209=100,Nagra=40;Temp=27 C

Wind=400gt600 fpm from N.



FIG. 55

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 51.0 |
| 8 | 8.0 | 54.0 |
| 9 | 10.0 | 56.2 |
| 10 | 12.5 | 62.6 |
| 11 | 16.0 | 69.0 |
| 12 | 20.0 | 84.8 |
| 13 | 25.0 | 81.0 |
| 14 | 31.5 | 82.9 |
| 15 | 40.0 | 96.6 |
| 16 | 50.0 | 91.3 |
| 17 | 63.0 | 91.8 |
| 18 | 80.0 | 95.3 |
| 19 | 100.0 | 95.6 |
| 20 | 125.0 | 92.3 |
| 21 | 160.0 | 85.9 |
| 22 | 200.0 | 92.3 |
| 23 | 250.0 | 87.6 |
| 24 | 315.0 | 88.5 |
| 25 | 400.0 | 89.7 |
| 26 | 500.0 | 84.5 |
| 27 | 630.0 | 85.1 |
| 28 | 800.0 | 86.8 |
| 29 | 1000.0 | 82.8 |
| 30 | 1250.0 | 81.8 |
| 31 | 1600.0 | 84.6 |
| 32 | 2000.0 | 86.0 |
| 33 | 2500.0 | 80.1 |
| 34 | 3150.0 | 81.0 |
| 35 | 4000.0 | 75.4 |
| 36 | 5000.0 | 75.3 |
| 37 | 6300.0 | 76.6 |
| 38 | 8000.0 | 72.7 |
| 39 | 10000.0 | 71.1 |
| 40 | 12500.0 | 69.2 |




Tape#2;Noise Levels;Avg:Lin 16s

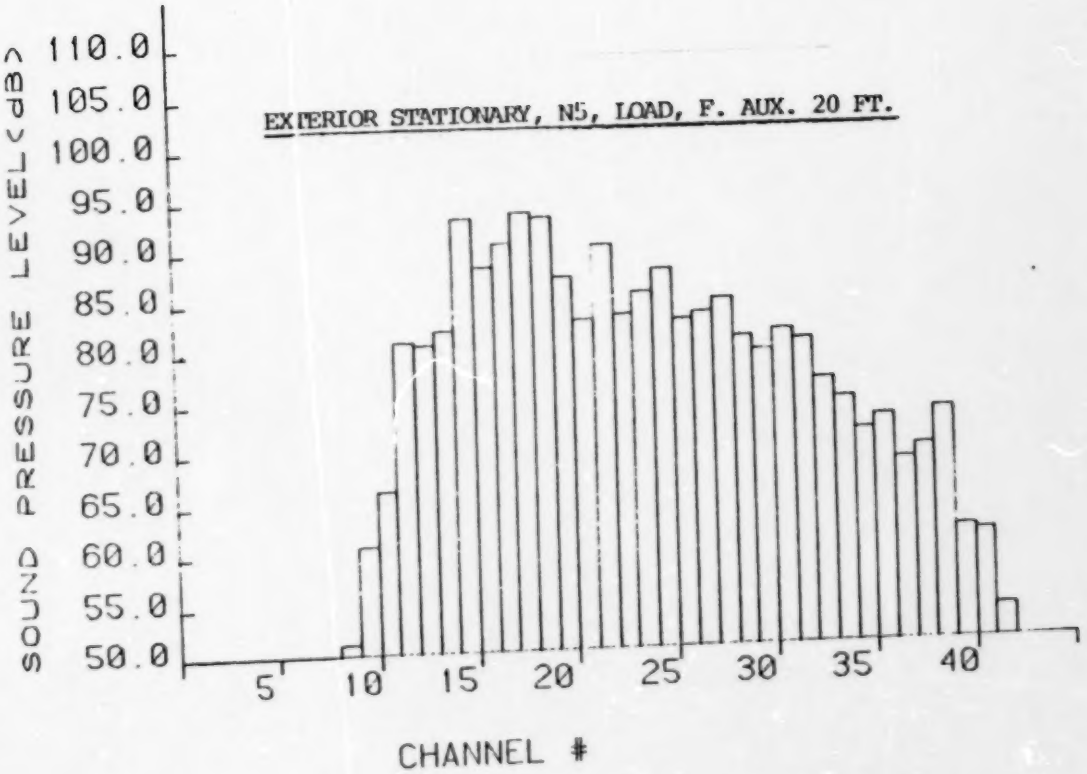
Loco#2534;Eng Speed= N6 ;Aux Load=Full

Turbo In. Cone Rem;78/08/16;0900hr

Mic Ht=4ft;Mic Pos= 20ft/RHS

All 2209=100 Nagra=40;Temp=27 C

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 50.0 |
| 9 | 10.0 | 51.2 |
| 10 | 12.5 | 60.8 |
| 11 | 16.0 | 66.3 |
| 12 | 20.0 | 81.0 |
| 13 | 25.0 | 80.5 |
| 14 | 31.5 | 82.0 |
| 15 | 40.0 | 93.1 |
| 16 | 50.0 | 88.3 |
| 17 | 63.0 | 90.6 |
| 18 | 80.0 | 93.6 |
| 19 | 100.0 | 93.0 |
| 20 | 125.0 | 87.1 |
| 21 | 160.0 | 82.8 |
| 22 | 200.0 | 90.2 |
| 23 | 250.0 | 83.2 |
| 24 | 315.0 | 85.3 |
| 25 | 400.0 | 87.6 |
| 26 | 500.0 | 82.5 |
| 27 | 630.0 | 83.1 |
| 28 | 800.0 | 84.5 |
| 29 | 1000.0 | 80.7 |
| 30 | 1250.0 | 79.2 |
| 31 | 1600.0 | 81.3 |
| 32 | 2000.0 | 80.3 |
| 33 | 2500.0 | 76.3 |
| 34 | 3150.0 | 74.3 |
| 35 | 4000.0 | 71.2 |
| 36 | 5000.0 | 72.6 |
| 37 | 6300.0 | 68.2 |
| 38 | 8000.0 | 69.6 |
| 39 | 10000.0 | 73.0 |
| 40 | 12500.0 | 61.3 |
| 41 | 16000.0 | 50.8 |
| 42 | 20000.0 | 53.3 |




Tape#2;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed= N5 ;Aux Load=Full

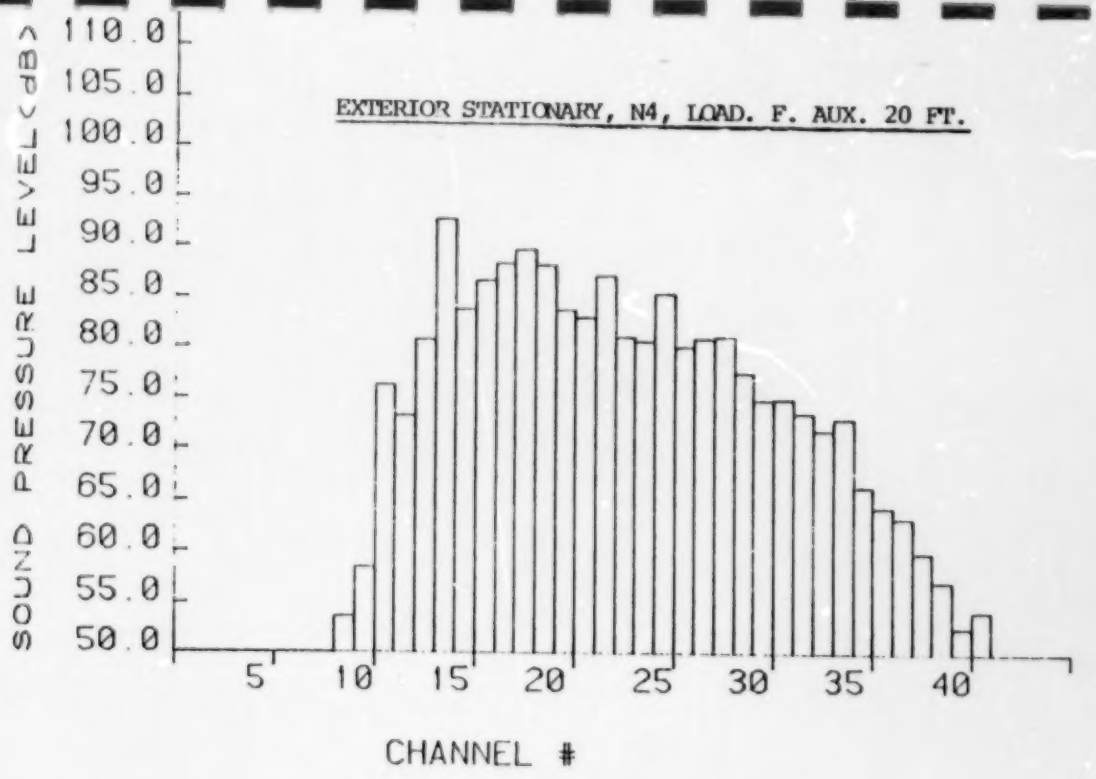
Turbo In. Cone Rem;78/08/16;0900hr

Mic Ht=4ft;Mic Pos=20 ft/RHS

Att:2209=100,Nagra=40;Temp=27 C

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 50.0 |
| 9 | 10.0 | 53.7 |
| 10 | 12.5 | 58.4 |
| 11 | 16.0 | 76.5 |
| 12 | 20.0 | 73.4 |
| 13 | 25.0 | 81.0 |
| 14 | 31.5 | 92.9 |
| 15 | 40.0 | 84.0 |
| 16 | 50.0 | 86.9 |
| 17 | 63.0 | 88.5 |
| 18 | 80.0 | 90.0 |
| 19 | 100.0 | 88.4 |
| 20 | 125.0 | 83.9 |
| 21 | 160.0 | 83.2 |
| 22 | 200.0 | 87.3 |
| 23 | 250.0 | 81.2 |
| 24 | 315.0 | 80.8 |
| 25 | 400.0 | 85.5 |
| 26 | 500.0 | 80.3 |
| 27 | 630.0 | 81.1 |
| 28 | 800.0 | 81.2 |
| 29 | 1000.0 | 77.8 |
| 30 | 1250.0 | 74.9 |
| 31 | 1600.0 | 75.1 |
| 32 | 2000.0 | 73.7 |
| 33 | 2500.0 | 72.0 |
| 34 | 3150.0 | 73.2 |
| 35 | 4000.0 | 66.6 |
| 36 | 5000.0 | 64.5 |
| 37 | 6300.0 | 63.5 |
| 38 | 8000.0 | 60.0 |
| 39 | 10000.0 | 57.1 |
| 40 | 12500.0 | 52.6 |
| 41 | 16000.0 | 54.3 |
| 42 | 20000.0 | 49.3 |

WEIGHTED LEVEL 88.5dB




Tape#2;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed= N4 ;Aux Load=Full

Turbo In.Cone Rem ;78/08/16;0900hr

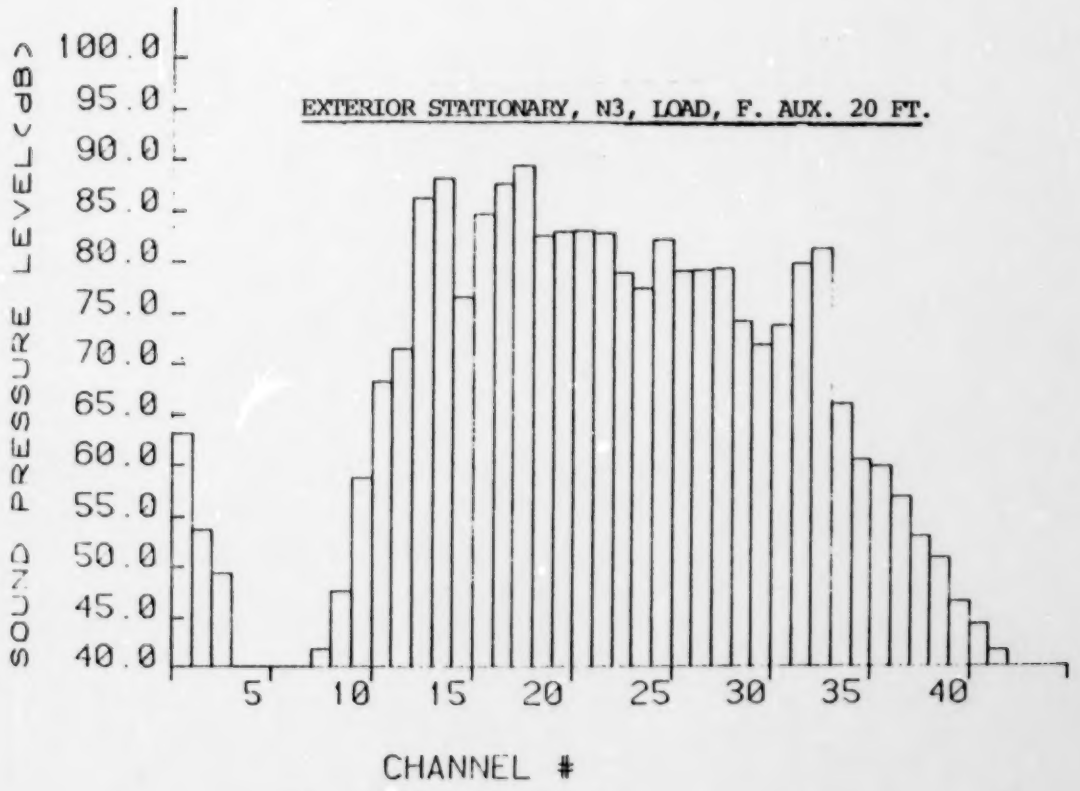
Mic Ht=4ft;Mic Pos= 20ft/RHS

Att:2209=90,Nagra=40;Temp=27 C

Wind=400gt600 fpm from N.

FIG. 58

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 63.2 |
| 2 | 2.0 | 53.7 |
| 3 | 2.5 | 49.4 |
| 4 | 3.2 | 40.0 |
| 5 | 4.0 | 40.0 |
| 6 | 5.0 | 40.0 |
| 7 | 6.3 | 40.0 |
| 8 | 8.0 | 41.8 |
| 9 | 10.0 | 47.6 |
| 10 | 12.5 | 58.7 |
| 11 | 16.0 | 68.2 |
| 12 | 20.0 | 71.4 |
| 13 | 25.0 | 86.3 |
| 14 | 31.5 | 88.2 |
| 15 | 40.0 | 76.6 |
| 16 | 50.0 | 84.8 |
| 17 | 63.0 | 87.7 |
| 18 | 80.0 | 89.6 |
| 19 | 100.0 | 82.6 |
| 20 | 125.0 | 83.0 |
| 21 | 160.0 | 83.2 |
| 22 | 200.0 | 82.9 |
| 23 | 250.0 | 79.1 |
| 24 | 315.0 | 77.4 |
| 25 | 400.0 | 82.3 |
| 26 | 500.0 | 79.1 |
| 27 | 630.0 | 79.3 |
| 28 | 800.0 | 79.4 |
| 29 | 1000.0 | 74.2 |
| 30 | 1250.0 | 71.8 |
| 31 | 1600.0 | 73.8 |
| 32 | 2000.0 | 80.0 |
| 33 | 2500.0 | 81.4 |
| 34 | 3150.0 | 66.1 |
| 35 | 4000.0 | 60.6 |
| 36 | 5000.0 | 60.0 |
| 37 | 6300.0 | 57.0 |
| 38 | 8000.0 | 53.0 |
| 39 | 10000.0 | 50.9 |
| 40 | 12500.0 | 46.6 |
| 41 | 16000.0 | 44.3 |
| 42 | 20000.0 | 41.7 |




Tape#2;Noise Levels;Avg:Lin 16s

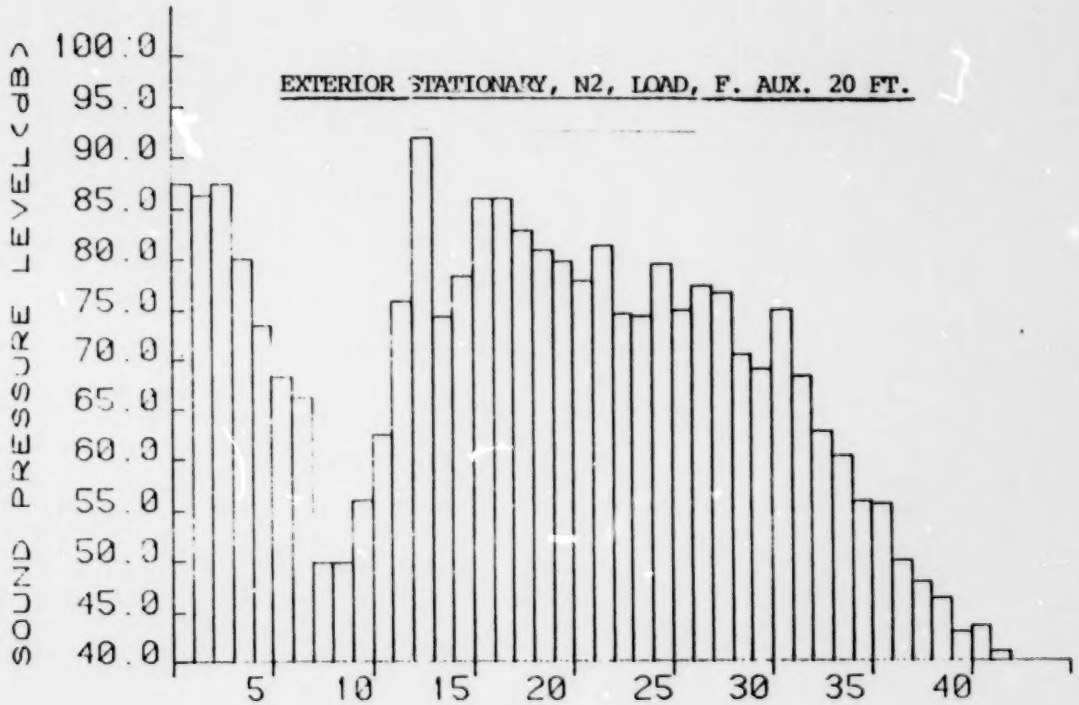
Loco#2534;Eng Speed= N3 ;Aux Load=Full

Turbo In.Cone Rem ;78/08/16;0900hr

Mic Ht=4ft;Mic Pos= 20ft/RHS

Att:2209=90,Nagra=40;Temp=27 C

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 87.4 |
| 2 | 2.0 | 86.3 |
| 3 | 2.5 | 87.4 |
| 4 | 3.2 | 80.0 |
| 5 | 4.0 | 73.4 |
| 6 | 5.0 | 68.2 |
| 7 | 6.3 | 66.1 |
| 8 | 8.0 | 49.9 |
| 9 | 10.0 | 49.9 |
| 10 | 12.5 | 56.0 |
| 11 | 16.0 | 62.6 |
| 12 | 20.0 | 75.9 |
| 13 | 25.0 | 92.0 |
| 14 | 31.5 | 74.3 |
| 15 | 40.0 | 78.4 |
| 16 | 50.0 | 86.1 |
| 17 | 63.0 | 86.0 |
| 18 | 80.0 | 82.9 |
| 19 | 100.0 | 81.0 |
| 20 | 125.0 | 79.8 |
| 21 | 160.0 | 77.8 |
| 22 | 200.0 | 81.4 |
| 23 | 250.0 | 74.6 |
| 24 | 315.0 | 74.3 |
| 25 | 400.0 | 79.5 |
| 26 | 500.0 | 74.9 |
| 27 | 630.0 | 77.3 |
| 28 | 800.0 | 76.5 |
| 29 | 1000.0 | 70.5 |
| 30 | 1250.0 | 69.0 |
| 31 | 1600.0 | 74.9 |
| 32 | 2000.0 | 68.3 |
| 33 | 2500.0 | 62.8 |
| 34 | 3150.0 | 60.3 |
| 35 | 4000.0 | 55.9 |
| 36 | 5000.0 | 55.7 |
| 37 | 6300.0 | 50.1 |
| 38 | 8000.0 | 48.0 |
| 39 | 10000.0 | 46.2 |
| 40 | 12500.0 | 43.1 |
| 41 | 16000.0 | 43.5 |
| 42 | 20000.0 | 41.1 |




Tape#2;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed= N2 ;Aux Load=Full

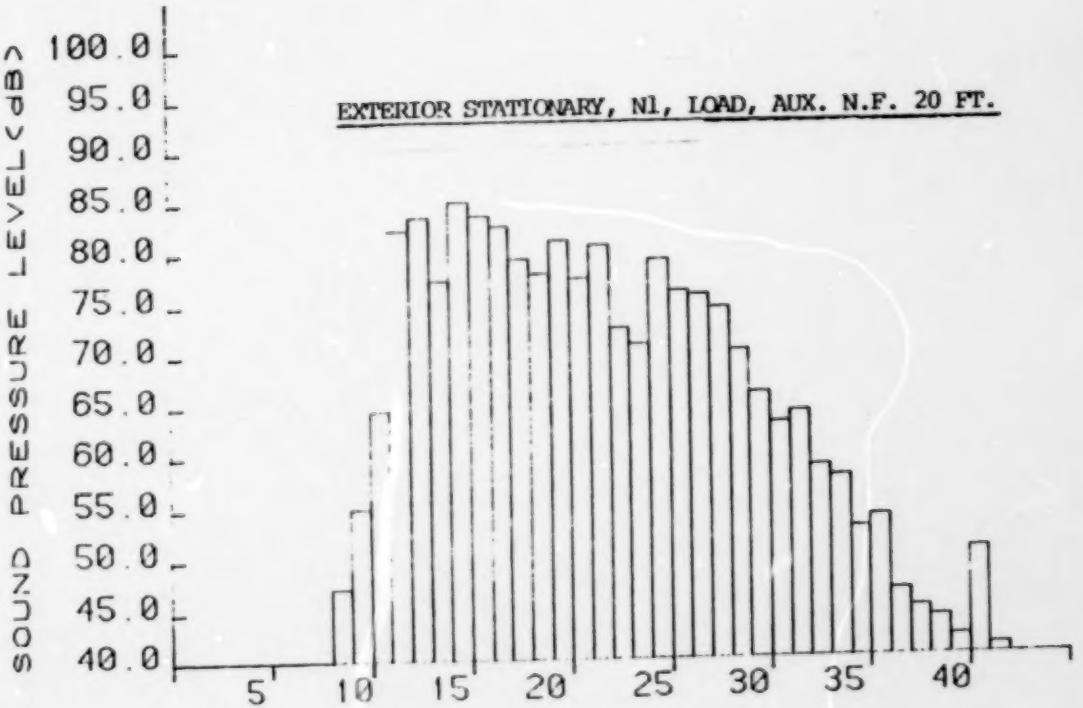
Turbo In. Cone Rem.;78/08/16;0900hr

Mic Ht=4ft;Mic Pos=20 ft/RHS

Att:2209=90,Nagra=40;Temp=27 C

Wind=400~1600 f--- f--- N

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 40.0 |
| 2 | 2.0 | 40.0 |
| 3 | 2.5 | 40.0 |
| 4 | 3.2 | 40.0 |
| 5 | 4.0 | 40.0 |
| 6 | 5.0 | 40.0 |
| 7 | 6.3 | 40.0 |
| 8 | 8.0 | 40.0 |
| 9 | 10.0 | 47.2 |
| 10 | 12.5 | 55.0 |
| 11 | 16.0 | 64.5 |
| 12 | 20.0 | 82.2 |
| 13 | 25.0 | 83.5 |
| 14 | 31.5 | 77.3 |
| 15 | 40.0 | 85.2 |
| 16 | 50.0 | 83.7 |
| 17 | 63.0 | 82.7 |
| 18 | 80.0 | 79.4 |
| 19 | 100.0 | 77.9 |
| 20 | 125.0 | 81.2 |
| 21 | 160.0 | 77.5 |
| 22 | 200.0 | 80.8 |
| 23 | 250.0 | 72.6 |
| 24 | 315.0 | 71.0 |
| 25 | 400.0 | 79.2 |
| 26 | 500.0 | 76.2 |
| 27 | 630.0 | 75.7 |
| 28 | 800.0 | 74.5 |
| 29 | 1000.0 | 70.3 |
| 30 | 1250.0 | 66.0 |
| 31 | 1600.0 | 63.2 |
| 32 | 2000.0 | 64.2 |
| 33 | 2500.0 | 58.9 |
| 34 | 3150.0 | 57.9 |
| 35 | 4000.0 | 52.8 |
| 36 | 5000.0 | 54.0 |
| 37 | 6300.0 | 46.7 |
| 38 | 8000.0 | 45.0 |
| 39 | 10000.0 | 43.9 |
| 40 | 12500.0 | 42.0 |
| 41 | 16000.0 | 50.5 |
| 42 | 20000.0 | 41.1 |




Tape#2;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed= N1 ;Aux Load

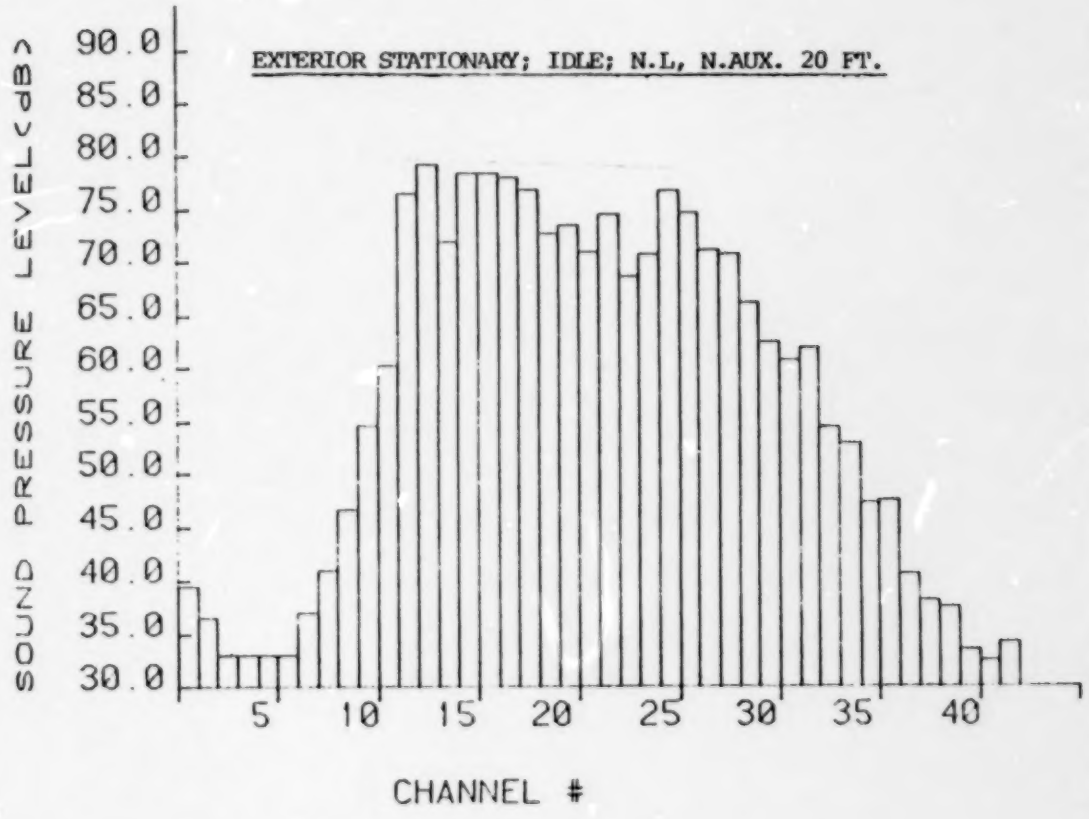
Turbo In.Cone Rem.;78/08/16;0900hr

Mic Ht=4ft;Mic Pos=20 ft/RHS

Att:2209=90,Nagra=40;Temp=27 C

Wind=400at600 fpm from N

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 39.5 |
| 2 | 2.0 | 36.5 |
| 3 | 2.5 | 33.0 |
| 4 | 3.2 | 33.0 |
| 5 | 4.0 | 33.0 |
| 6 | 5.0 | 33.0 |
| 7 | 6.3 | 37.0 |
| 8 | 8.0 | 40.9 |
| 9 | 10.0 | 46.7 |
| 10 | 12.5 | 54.6 |
| 11 | 16.0 | 60.4 |
| 12 | 20.0 | 76.6 |
| 13 | 25.0 | 79.3 |
| 14 | 31.5 | 72.0 |
| 15 | 40.0 | 78.6 |
| 16 | 50.0 | 78.6 |
| 17 | 63.0 | 78.1 |
| 18 | 80.0 | 77.0 |
| 19 | 100.0 | 72.8 |
| 20 | 125.0 | 73.5 |
| 21 | 160.0 | 71.1 |
| 22 | 200.0 | 74.6 |
| 23 | 250.0 | 68.8 |
| 24 | 315.0 | 70.8 |
| 25 | 400.0 | 76.8 |
| 26 | 500.0 | 74.7 |
| 27 | 630.0 | 71.2 |
| 28 | 800.0 | 70.8 |
| 29 | 1000.0 | 66.3 |
| 30 | 1250.0 | 62.5 |
| 31 | 1600.0 | 60.8 |
| 32 | 2000.0 | 62.0 |
| 33 | 2500.0 | 54.4 |
| 34 | 3150.0 | 52.9 |
| 35 | 4000.0 | 47.4 |
| 36 | 5000.0 | 47.6 |
| 37 | 6300.0 | 40.7 |
| 38 | 8000.0 | 38.3 |
| 39 | 10000.0 | 37.6 |
| 40 | 12500.0 | 33.6 |
| 41 | 16000.0 | 32.5 |




Tape#1;Noise Levels;Avg:Lin 16s

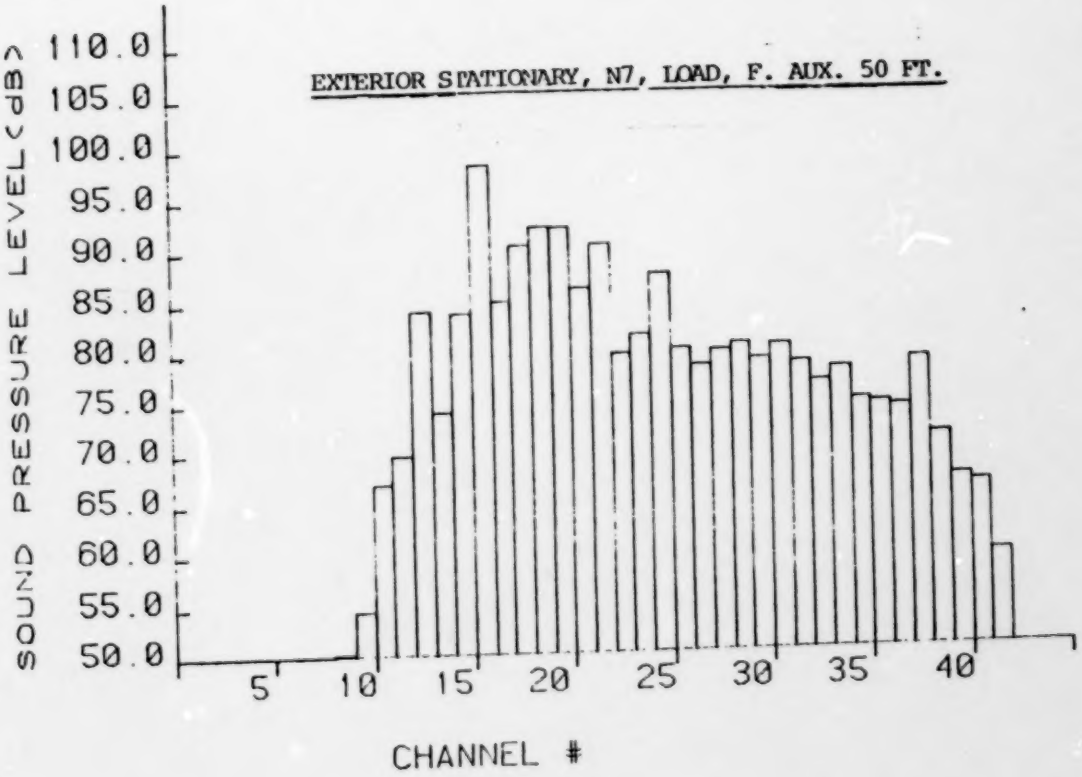
Loco#2534;Eng Speed=Idle;

Hotel Load=Nil ;78/08/15;1600hr

Mic Ht=5ft;Mic Pos= 20ft/LHS

Att:2209=80,Nagra=43;Temp=45 C

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 50.0 |
| 9 | 10.0 | 50.2 |
| 10 | 12.5 | 54.4 |
| 11 | 16.0 | 67.0 |
| 12 | 20.0 | 69.7 |
| 13 | 25.0 | 84.0 |
| 14 | 31.5 | 74.0 |
| 15 | 40.0 | 83.9 |
| 16 | 50.0 | 98.4 |
| 17 | 63.0 | 85.0 |
| 18 | 80.0 | 90.5 |
| 19 | 100.0 | 92.2 |
| 20 | 125.0 | 92.1 |
| 21 | 160.0 | 86.1 |
| 22 | 200.0 | 90.5 |
| 23 | 250.0 | 79.7 |
| 24 | 315.0 | 81.4 |
| 25 | 400.0 | 87.5 |
| 26 | 500.0 | 80.0 |
| 27 | 630.0 | 78.4 |
| 28 | 800.0 | 79.8 |
| 29 | 1000.0 | 80.5 |
| 30 | 1250.0 | 78.8 |
| 31 | 1600.0 | 80.4 |
| 32 | 2000.0 | 78.5 |
| 33 | 2500.0 | 76.5 |
| 34 | 3150.0 | 77.9 |
| 35 | 4000.0 | 74.7 |
| 36 | 5000.0 | 74.3 |
| 37 | 6300.0 | 74.0 |
| 38 | 8000.0 | 78.6 |
| 39 | 10000.0 | 71.1 |
| 40 | 12500.0 | 66.9 |
| 41 | 16000.0 | 66.2 |
| 42 | 20000.0 | 59.3 |




Tape#3;Noise Levels;Avg:Lin 16s

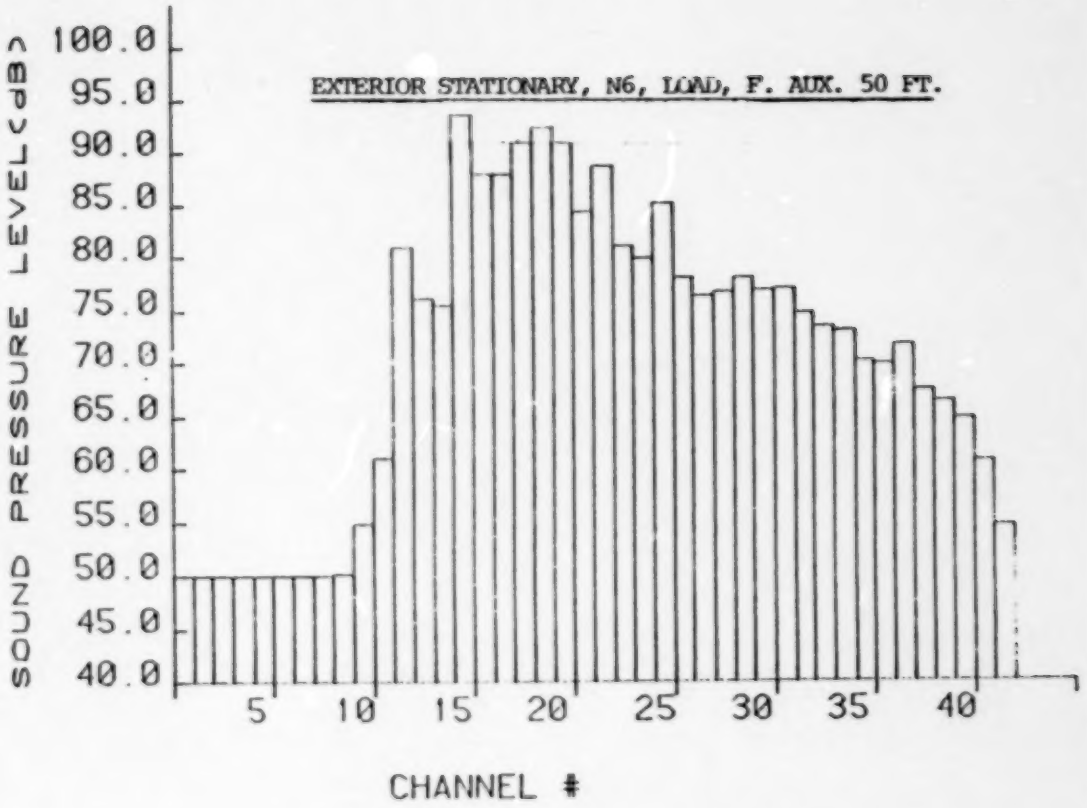
Loco#2534;Eng Speed= N7 ;Aux Load=Full

Turbo In. Cone Rem;78/08/23;1120hr

Mic Pos= 50ft/RHS

Att:2209=100,Nagra=40

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 50.0 |
| 9 | 10.0 | 50.2 |
| 10 | 12.5 | 54.8 |
| 11 | 16.0 | 61.1 |
| 12 | 20.0 | 81.1 |
| 13 | 25.0 | 76.3 |
| 14 | 31.5 | 75.6 |
| 15 | 40.0 | 93.7 |
| 16 | 50.0 | 88.2 |
| 17 | 63.0 | 88.1 |
| 18 | 80.0 | 91.1 |
| 19 | 100.0 | 92.4 |
| 20 | 125.0 | 91.1 |
| 21 | 160.0 | 84.5 |
| 22 | 200.0 | 88.9 |
| 23 | 250.0 | 81.3 |
| 24 | 315.0 | 80.1 |
| 25 | 400.0 | 85.2 |
| 26 | 500.0 | 78.2 |
| 27 | 630.0 | 76.5 |
| 28 | 800.0 | 76.9 |
| 29 | 1000.0 | 78.3 |
| 30 | 1250.0 | 77.0 |
| 31 | 1600.0 | 77.2 |
| 32 | 2000.0 | 74.9 |
| 33 | 2500.0 | 73.6 |
| 34 | 3150.0 | 73.2 |
| 35 | 4000.0 | 70.4 |
| 36 | 5000.0 | 70.1 |
| 37 | 6300.0 | 71.9 |
| 38 | 8000.0 | 67.6 |
| 39 | 10000.0 | 66.5 |
| 40 | 12500.0 | 64.9 |
| 41 | 16000.0 | 60.8 |




Tape#3;Noise Levels;Avg:Lin 16s

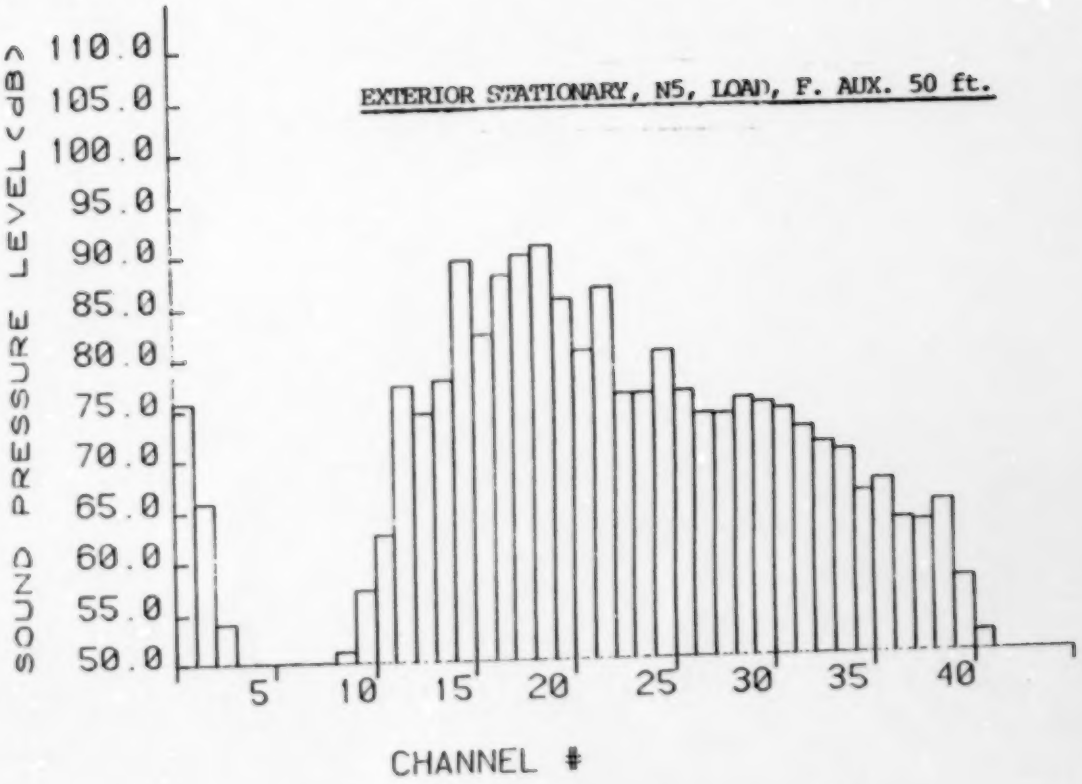
Loco#2534;Eng Speed= N6 ;Aux Load=Full

Turbo In.Cone Rem;78/08/23;1120hr

Mic Pos= 50ft/RHS

Att:2209=90,Nagra=50

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 75.7 |
| 2 | 2.0 | 65.9 |
| 3 | 2.5 | 54.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 50.0 |
| 9 | 10.0 | 51.2 |
| 10 | 12.5 | 57.2 |
| 11 | 16.0 | 62.5 |
| 12 | 20.0 | 77.2 |
| 13 | 25.0 | 74.5 |
| 14 | 31.5 | 77.7 |
| 15 | 40.0 | 89.4 |
| 16 | 50.0 | 82.1 |
| 17 | 63.0 | 88.0 |
| 18 | 80.0 | 90.0 |
| 19 | 100.0 | 90.8 |
| 20 | 125.0 | 85.5 |
| 21 | 160.0 | 80.4 |
| 22 | 200.0 | 86.6 |
| 23 | 250.0 | 76.2 |
| 24 | 315.0 | 76.1 |
| 25 | 400.0 | 80.3 |
| 26 | 500.0 | 76.2 |
| 27 | 630.0 | 74.0 |
| 28 | 800.0 | 73.9 |
| 29 | 1000.0 | 75.5 |
| 30 | 1250.0 | 74.9 |
| 31 | 1600.0 | 74.3 |
| 32 | 2000.0 | 72.5 |
| 33 | 2500.0 | 70.9 |
| 34 | 3150.0 | 70.2 |
| 35 | 4000.0 | 66.1 |
| 36 | 5000.0 | 67.2 |
| 37 | 6300.0 | 63.3 |
| 38 | 8000.0 | 63.1 |
| 39 | 10000.0 | 65.0 |
| 40 | 12500.0 | 57.5 |
| 41 | 16000.0 | 51.9 |
| 42 | 20000.0 | 49.3 |




Tape#3;Noise Levels;Avg:Lin 16s

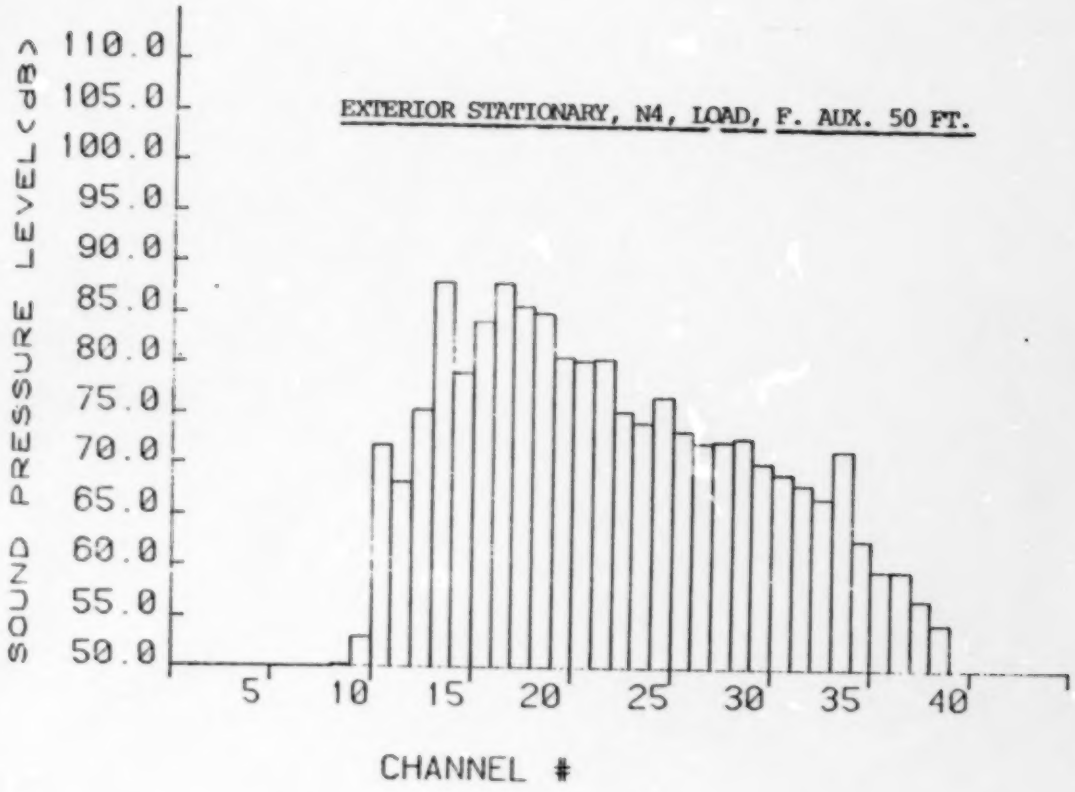
Loco#2534;Eng Speed= N5 ;Aux Load=Full

Turbo In.Cone Rem;78/08/23;1120hr

Mic Pos= 50ft/RHS

Att:2209=90,Nagra=40

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 50.0 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 50.0 |
| 9 | 10.0 | 50.2 |
| 10 | 12.5 | 53.0 |
| 11 | 16.0 | 71.9 |
| 12 | 20.0 | 68.2 |
| 13 | 25.0 | 75.3 |
| 14 | 31.5 | 88.0 |
| 15 | 40.0 | 79.1 |
| 16 | 50.0 | 84.1 |
| 17 | 63.0 | 87.8 |
| 18 | 80.0 | 85.7 |
| 19 | 100.0 | 85.0 |
| 20 | 125.0 | 80.5 |
| 21 | 160.0 | 80.3 |
| 22 | 200.0 | 80.5 |
| 23 | 250.0 | 75.3 |
| 24 | 315.0 | 74.2 |
| 25 | 400.0 | 76.6 |
| 26 | 500.0 | 73.4 |
| 27 | 630.0 | 72.2 |
| 28 | 800.0 | 72.3 |
| 29 | 1000.0 | 72.8 |
| 30 | 1250.0 | 70.3 |
| 31 | 1600.0 | 69.3 |
| 32 | 2000.0 | 68.3 |
| 33 | 2500.0 | 66.9 |
| 34 | 3150.0 | 71.6 |
| 35 | 4000.0 | 62.8 |
| 36 | 5000.0 | 59.8 |
| 37 | 6300.0 | 59.8 |
| 38 | 8000.0 | 56.9 |
| 39 | 10000.0 | 54.6 |
| 40 | 12500.0 | 49.6 |
| 41 | 16000.0 | 49.5 |
| 42 | 20000.0 | 49.3 |




Tape#3;Noise Levels;Avg:Lin 16s

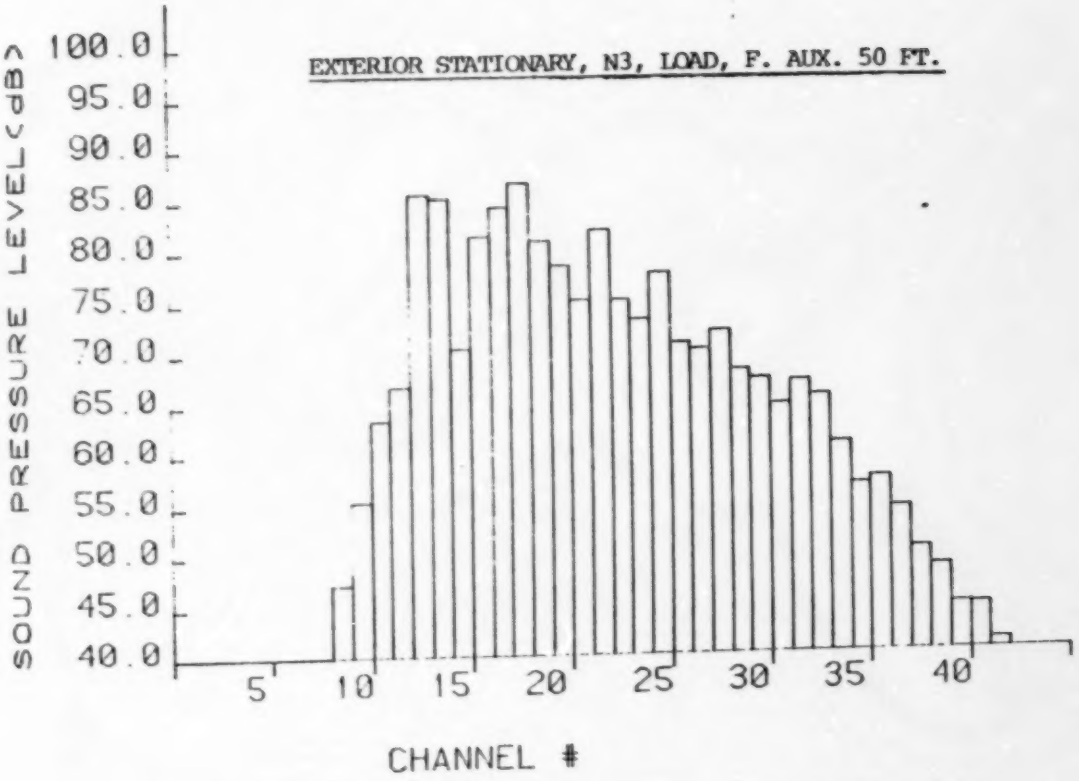
Loco#2534;Eng Speed= N4 ;Aux Load=Full

Turbo In. Cone Rem;78/08/23;1120hr

Mic Pos= 50ft/RHS

Att:2209= ,Nagra= ;Temp= Att:2209=90,N

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 40.0 |
| 2 | 2.0 | 40.0 |
| 3 | 2.5 | 40.0 |
| 4 | 3.2 | 40.0 |
| 5 | 4.0 | 40.0 |
| 6 | 5.0 | 40.0 |
| 7 | 6.3 | 40.0 |
| 8 | 8.0 | 40.0 |
| 9 | 10.0 | 47.2 |
| 10 | 12.5 | 55.3 |
| 11 | 16.0 | 63.4 |
| 12 | 20.0 | 66.6 |
| 13 | 25.0 | 85.6 |
| 14 | 31.5 | 85.3 |
| 15 | 40.0 | 70.5 |
| 16 | 50.0 | 81.5 |
| 17 | 63.0 | 84.3 |
| 18 | 80.0 | 86.7 |
| 19 | 100.0 | 81.0 |
| 20 | 125.0 | 78.5 |
| 21 | 160.0 | 75.1 |
| 22 | 200.0 | 82.0 |
| 23 | 250.0 | 75.1 |
| 24 | 315.0 | 73.2 |
| 25 | 400.0 | 77.7 |
| 26 | 500.0 | 70.8 |
| 27 | 630.0 | 70.1 |
| 28 | 800.0 | 72.0 |
| 29 | 1000.0 | 68.1 |
| 30 | 1250.0 | 67.2 |
| 31 | 1600.0 | 64.8 |
| 32 | 2000.0 | 66.9 |
| 33 | 2500.0 | 65.5 |
| 34 | 3150.0 | 60.9 |
| 35 | 4000.0 | 56.7 |
| 36 | 5000.0 | 57.4 |
| 37 | 6300.0 | 54.4 |
| 38 | 8000.0 | 50.3 |
| 39 | 10000.0 | 48.4 |
| 40 | 12500.0 | 44.7 |
| 41 | 16000.0 | 44.6 |
| 42 | 20000.0 | 41.1 |




Tape#3, Noise Levels; Avg:Lin 16s

Loco#2534; Eng Speed= N3 ; Aux Load=Full

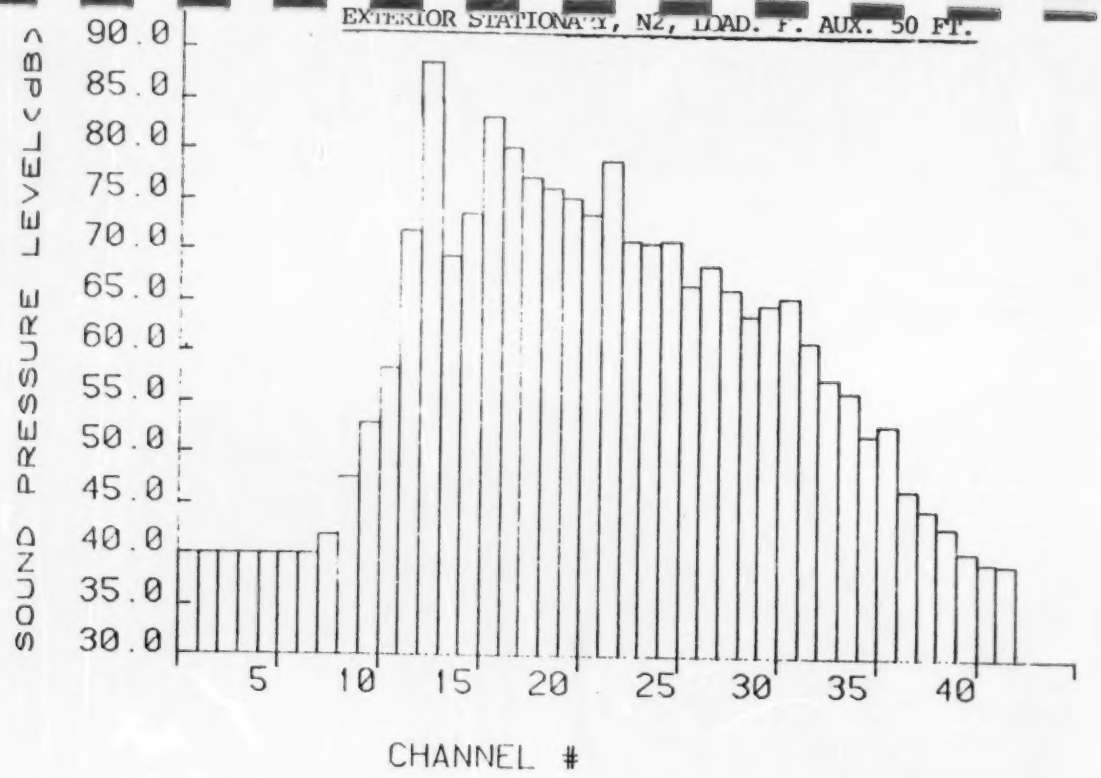
Turbo In. Cone Rem; 78/08/23; 1120hr

Mic Pos= 50ft/RHS

Att:2209=90, Nagra=40

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 40.0 |
| 2 | 2.0 | 40.0 |
| 3 | 2.5 | 40.0 |
| 4 | 3.2 | 40.0 |
| 5 | 4.0 | 40.0 |
| 6 | 5.0 | 40.0 |
| 7 | 6.3 | 40.0 |
| 8 | 8.0 | 41.8 |
| 9 | 10.0 | 47.6 |
| 10 | 12.5 | 52.9 |
| 11 | 16.0 | 58.4 |
| 12 | 20.0 | 72.0 |
| 13 | 25.0 | 88.7 |
| 14 | 31.5 | 69.5 |
| 15 | 40.0 | 73.9 |
| 16 | 50.0 | 83.5 |
| 17 | 63.0 | 80.5 |
| 18 | 80.0 | 77.5 |
| 19 | 100.0 | 76.4 |
| 20 | 125.0 | 75.4 |
| 21 | 160.0 | 73.8 |
| 22 | 200.0 | 79.2 |
| 23 | 250.0 | 71.2 |
| 24 | 315.0 | 71.0 |
| 25 | 400.0 | 71.2 |
| 26 | 500.0 | 66.8 |
| 27 | 630.0 | 68.7 |
| 28 | 800.0 | 66.4 |
| 29 | 1000.0 | 63.8 |
| 30 | 1250.0 | 64.9 |
| 31 | 1600.0 | 65.7 |
| 32 | 2000.0 | 61.2 |
| 33 | 2500.0 | 57.5 |
| 34 | 3150.0 | 56.3 |
| 35 | 4000.0 | 52.2 |
| 36 | 5000.0 | 53.0 |
| 37 | 6300.0 | 46.7 |
| 38 | 8000.0 | 44.7 |
| 39 | 10000.0 | 43.0 |
| 40 | 12500.0 | 40.6 |
| 41 | 16000.0 | 39.5 |
| 42 | 20000.0 | 39.3 |

A WEIGHTED LEVEL 76.4dB




Tape#3;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed= N2 ;Aux Load=Full

Turbo In.Cone Rem;78/08/23;1120hr

Mic Pos= 50ft/RHS

Att:2209=80,Nagra=50

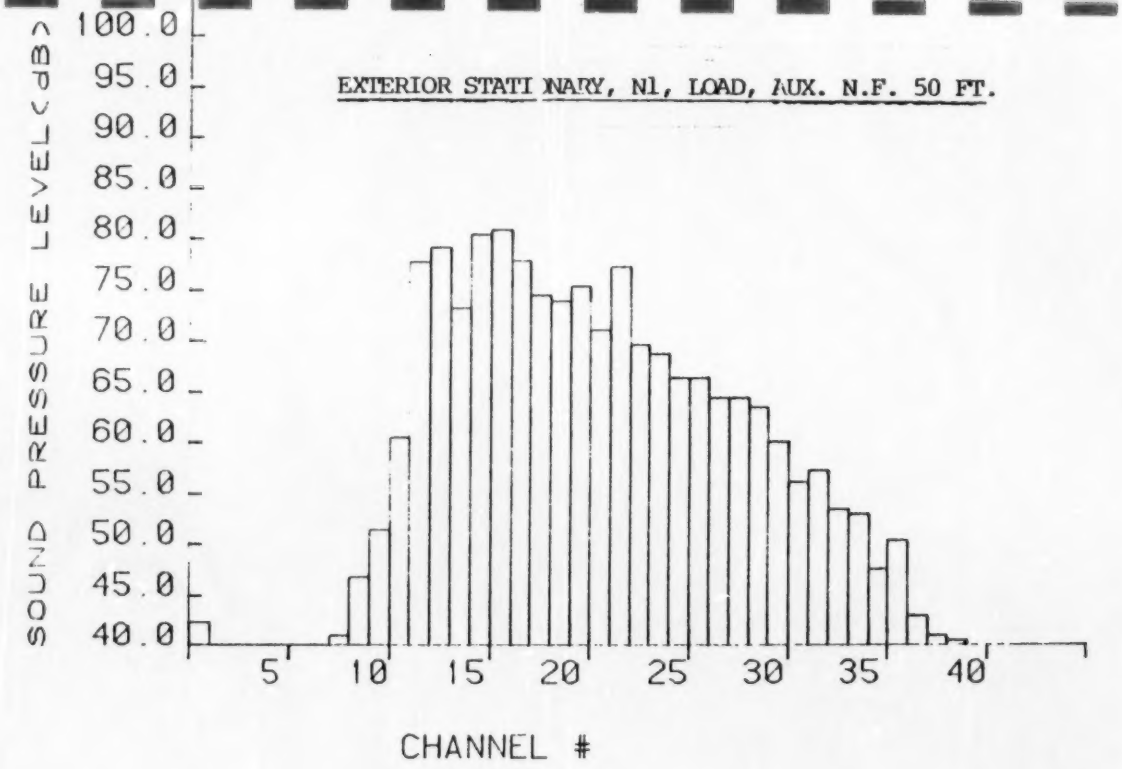
Wind=600gt800 fpm from N.



FIG. 68

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 42.4 |
| 2 | 2.0 | 40.0 |
| 3 | 2.5 | 40.0 |
| 4 | 3.2 | 40.0 |
| 5 | 4.0 | 40.0 |
| 6 | 5.0 | 40.0 |
| 7 | 6.3 | 40.0 |
| 8 | 8.0 | 41.0 |
| 9 | 10.0 | 46.7 |
| 10 | 12.5 | 51.5 |
| 11 | 16.0 | 60.6 |
| 12 | 20.0 | 77.7 |
| 13 | 25.0 | 79.1 |
| 14 | 31.5 | 73.1 |
| 15 | 40.0 | 80.5 |
| 16 | 50.0 | 81.0 |
| 17 | 63.0 | 77.8 |
| 18 | 80.0 | 74.5 |
| 19 | 100.0 | 73.9 |
| 20 | 125.0 | 75.4 |
| 21 | 160.0 | 71.1 |
| 22 | 200.0 | 77.4 |
| 23 | 250.0 | 69.7 |
| 24 | 315.0 | 68.7 |
| 25 | 400.0 | 66.4 |
| 26 | 500.0 | 66.4 |
| 27 | 630.0 | 64.5 |
| 28 | 800.0 | 64.4 |
| 29 | 1000.0 | 63.6 |
| 30 | 1250.0 | 60.2 |
| 31 | 1600.0 | 56.2 |
| 32 | 2000.0 | 57.4 |
| 33 | 2500.0 | 53.5 |
| 34 | 3150.0 | 53.0 |
| 35 | 4000.0 | 47.6 |
| 36 | 5000.0 | 50.5 |
| 37 | 6300.0 | 43.1 |
| 38 | 8000.0 | 41.1 |
| 39 | 10000.0 | 40.5 |
| 40 | 12500.0 | 39.6 |
| 41 | 16000.0 | 39.5 |
| 42 | 20000.0 | 39.3 |

A WEIGHTED LEVEL 73.6dB




Tape#3;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed= N1 ;Aux Load

Turbo In. Cone Rem;78/08/23;1120hr

Mic Pos= 50ft/RHS

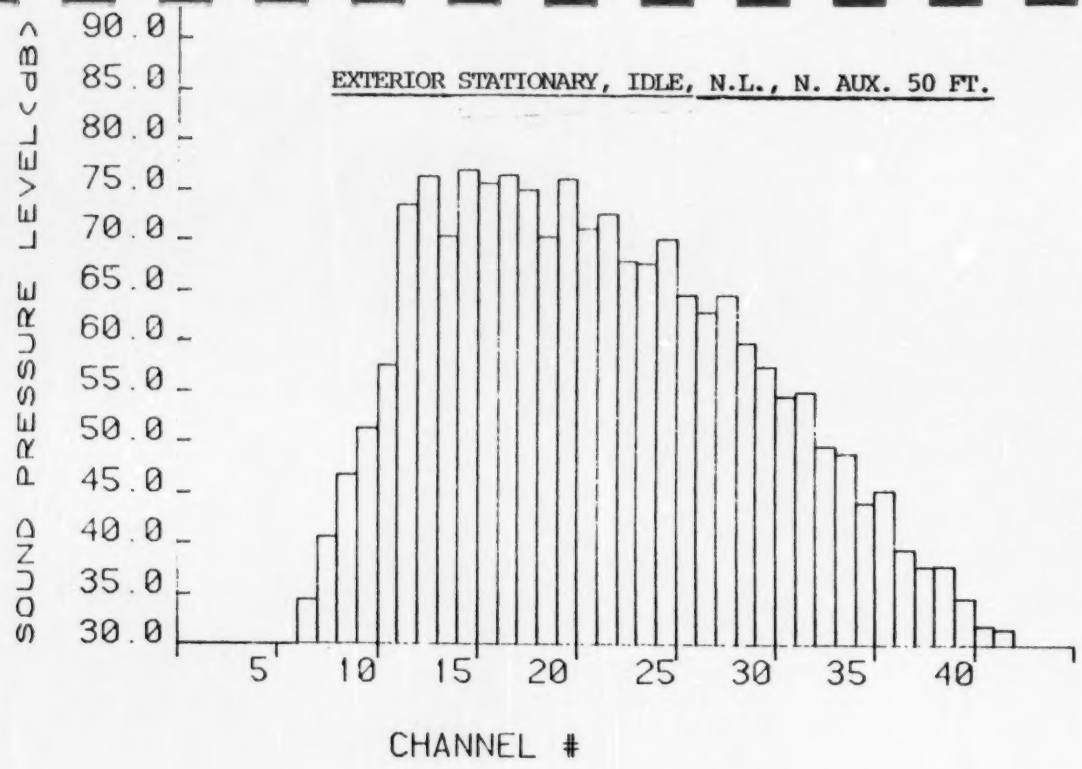
Att:2209=80,Nagra=40

Wind=600gt800 fpm from N.

FIG. 69

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 30.0 |
| 2 | 2.0 | 30.0 |
| 3 | 2.5 | 30.0 |
| 4 | 3.2 | 30.0 |
| 5 | 4.0 | 30.0 |
| 6 | 5.0 | 30.0 |
| 7 | 6.3 | 34.4 |
| 8 | 8.0 | 40.6 |
| 9 | 10.0 | 46.8 |
| 10 | 12.5 | 51.4 |
| 11 | 16.0 | 57.8 |
| 12 | 20.0 | 73.7 |
| 13 | 25.0 | 76.5 |
| 14 | 31.5 | 70.6 |
| 15 | 40.0 | 77.2 |
| 16 | 50.0 | 75.9 |
| 17 | 63.0 | 76.7 |
| 18 | 80.0 | 75.3 |
| 19 | 100.0 | 70.5 |
| 20 | 125.0 | 76.3 |
| 21 | 160.0 | 71.3 |
| 22 | 200.0 | 72.8 |
| 23 | 250.0 | 68.1 |
| 24 | 315.0 | 67.8 |
| 25 | 400.0 | 70.3 |
| 26 | 500.0 | 64.7 |
| 27 | 630.0 | 63.0 |
| 28 | 800.0 | 64.7 |
| 29 | 1000.0 | 59.9 |
| 30 | 1250.0 | 57.6 |
| 31 | 1600.0 | 54.8 |
| 32 | 2000.0 | 55.2 |
| 33 | 2500.0 | 49.8 |
| 34 | 3150.0 | 49.0 |
| 35 | 4000.0 | 44.2 |
| 36 | 5000.0 | 45.4 |
| 37 | 6300.0 | 39.5 |
| 38 | 8000.0 | 37.9 |
| 39 | 10000.0 | 37.9 |
| 40 | 12500.0 | 34.7 |
| 41 | 16000.0 | 31.9 |
| 42 | 20000.0 | 31.7 |

A WEIGHTED LEVEL 72.4dB




Tape#3;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=Idle;

Turbo In Cone Rem;78/08/23;1120hr

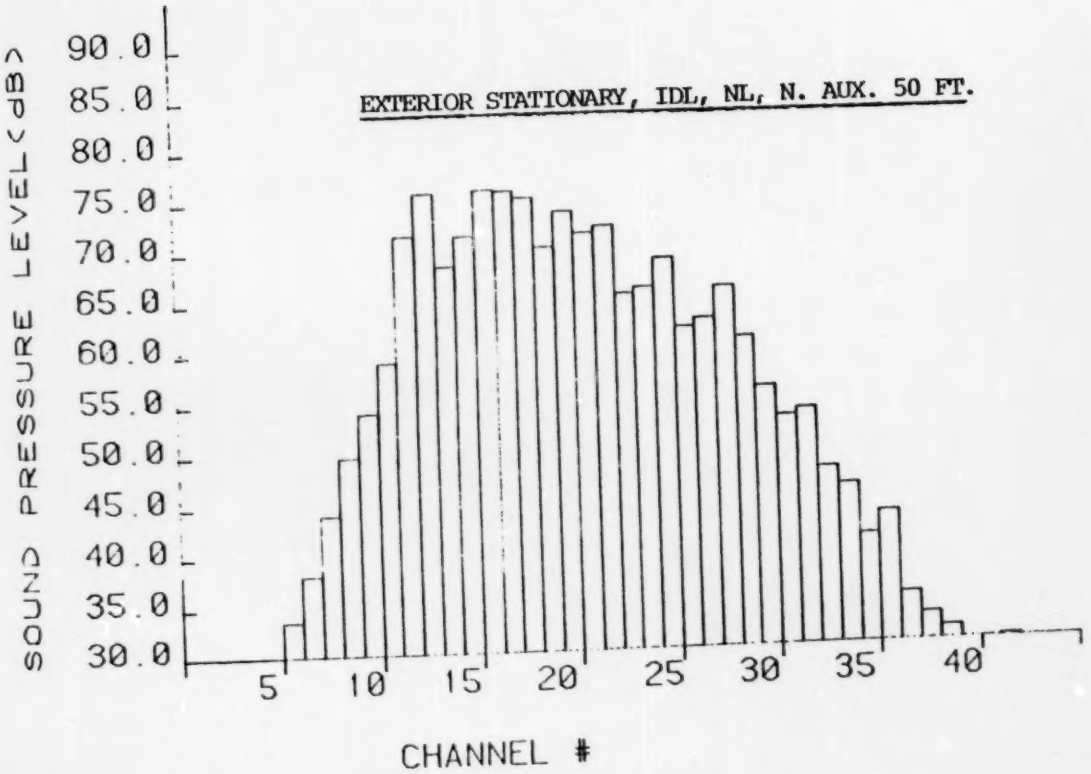
Mic Pos= 50ft/RHS

Att:2209=80,Nagra=40

Wind=600gt800 fpm from N.

FIG. 70

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 30.0 |
| 2 | 2.0 | 30.0 |
| 3 | 2.5 | 30.0 |
| 4 | 3.2 | 30.0 |
| 5 | 4.0 | 30.0 |
| 6 | 5.0 | 33.5 |
| 7 | 6.3 | 38.1 |
| 8 | 8.0 | 44.0 |
| 9 | 10.0 | 49.8 |
| 10 | 12.5 | 54.1 |
| 11 | 16.0 | 59.0 |
| 12 | 20.0 | 71.5 |
| 13 | 25.0 | 75.6 |
| 14 | 31.5 | 68.3 |
| 15 | 40.0 | 71.4 |
| 16 | 50.0 | 76.0 |
| 17 | 63.0 | 75.7 |
| 18 | 80.0 | 75.0 |
| 19 | 100.0 | 70.0 |
| 20 | 125.0 | 73.6 |
| 21 | 160.0 | 71.3 |
| 22 | 200.0 | 72.0 |
| 23 | 250.0 | 65.3 |
| 24 | 315.0 | 65.7 |
| 25 | 400.0 | 68.6 |
| 26 | 500.0 | 61.7 |
| 27 | 630.0 | 62.5 |
| 28 | 800.0 | 65.6 |
| 29 | 1000.0 | 60.6 |
| 30 | 1250.0 | 55.6 |
| 31 | 1600.0 | 52.8 |
| 32 | 2000.0 | 53.5 |
| 33 | 2500.0 | 47.6 |
| 34 | 3150.0 | 45.9 |
| 35 | 4000.0 | 40.9 |
| 36 | 5000.0 | 43.0 |
| 37 | 6300.0 | 34.8 |
| 38 | 8000.0 | 32.8 |
| 39 | 10000.0 | 31.3 |
| 40 | 12500.0 | 29.6 |
| 41 | 16000.0 | 29.5 |
| 42 | 20000.0 | 30.3 |




Tape#1;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=Idle;

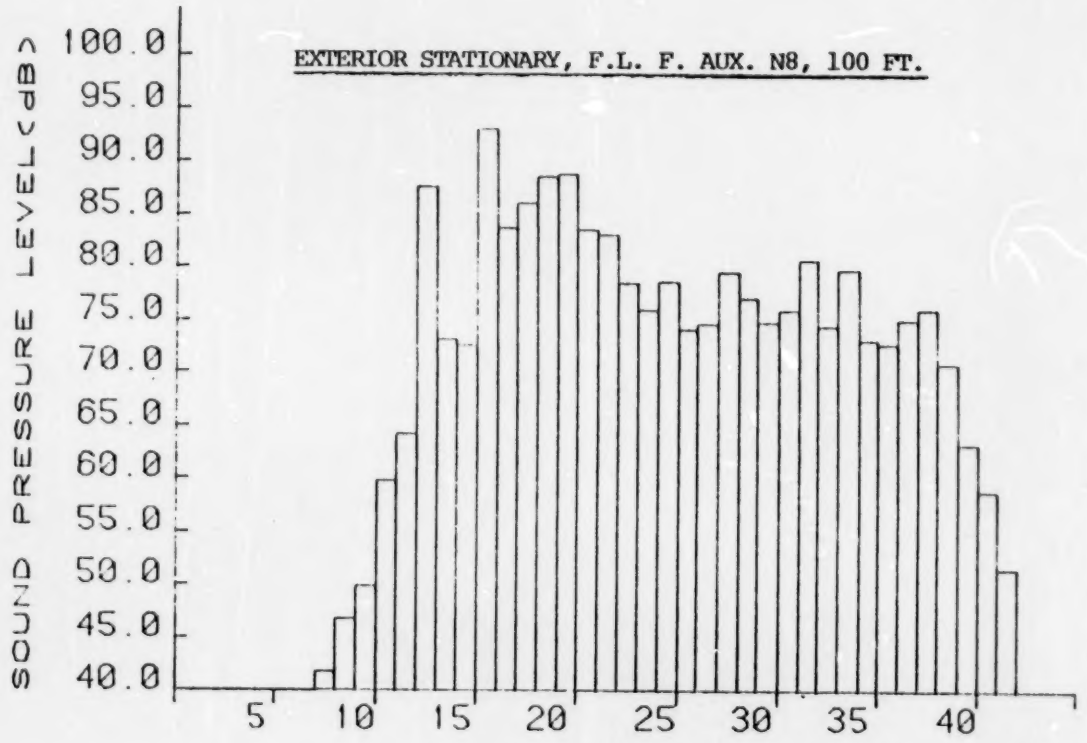
Hotel Load=Nil ;78/08/15;1600hr

Mic Ht=5ft;Mic Pos=50 ft/LHS

Att:2209=80,Nagra=40;Temp=45 C

Wind=600at800 fpm from N

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 40.0 |
| 2 | 2.0 | 40.0 |
| 3 | 2.5 | 40.0 |
| 4 | 3.2 | 40.0 |
| 5 | 4.0 | 40.0 |
| 6 | 5.0 | 40.0 |
| 7 | 6.3 | 40.0 |
| 8 | 8.0 | 41.8 |
| 9 | 10.0 | 46.7 |
| 10 | 12.5 | 49.9 |
| 11 | 16.0 | 59.8 |
| 12 | 20.0 | 64.2 |
| 13 | 25.0 | 87.6 |
| 14 | 31.5 | 73.2 |
| 15 | 40.0 | 72.7 |
| 16 | 50.0 | 93.1 |
| 17 | 63.0 | 83.8 |
| 18 | 80.0 | 86.2 |
| 19 | 100.0 | 88.6 |
| 20 | 125.0 | 88.9 |
| 21 | 160.0 | 83.7 |
| 22 | 200.0 | 83.2 |
| 23 | 250.0 | 78.6 |
| 24 | 315.0 | 76.0 |
| 25 | 400.0 | 78.7 |
| 26 | 500.0 | 74.2 |
| 27 | 630.0 | 74.7 |
| 28 | 800.0 | 79.7 |
| 29 | 1000.0 | 77.2 |
| 30 | 1250.0 | 74.9 |
| 31 | 1600.0 | 76.1 |
| 32 | 2000.0 | 80.9 |
| 33 | 2500.0 | 74.4 |
| 34 | 3150.0 | 80.0 |
| 35 | 4000.0 | 73.2 |
| 36 | 5000.0 | 72.8 |
| 37 | 6300.0 | 75.2 |
| 38 | 8000.0 | 76.2 |
| 39 | 10000.0 | 70.9 |
| 40 | 12500.0 | 63.3 |
| 41 | 16000.0 | 58.9 |




Tape#4;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N8 ;Aux Load=Full

Turbo In Cone Rem;78/08/23;1230hr

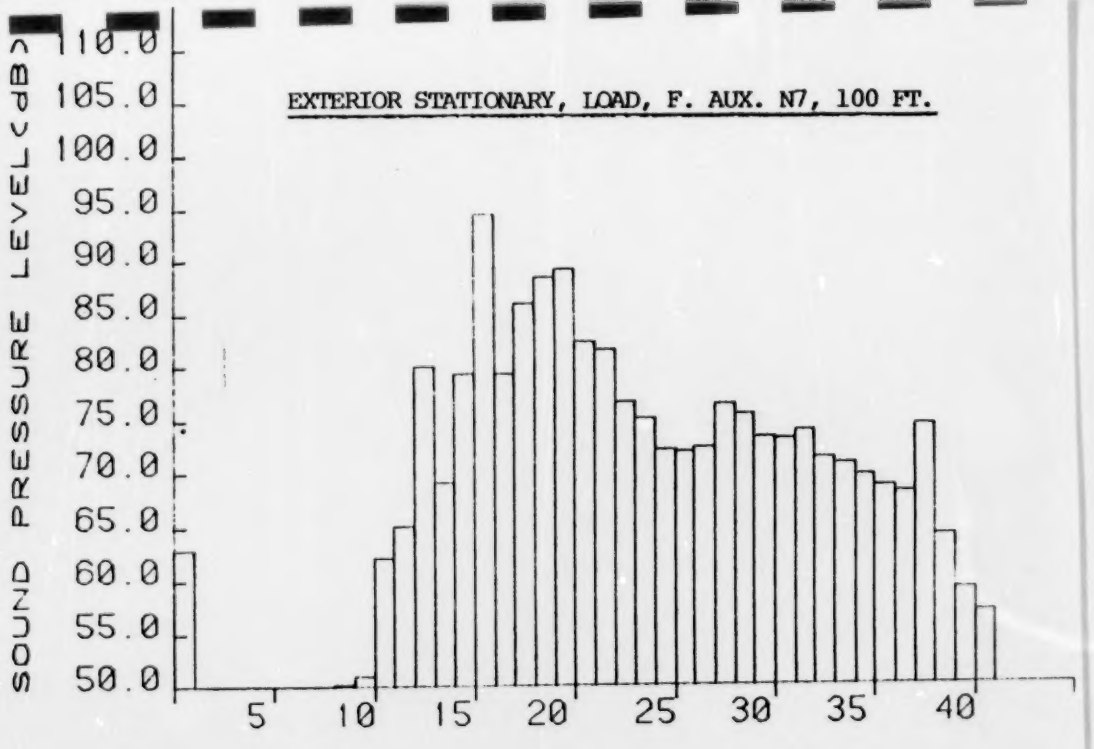
Mic Pos=100ft

Alt:2209=99 Nagra=40

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 62.9 |
| 2 | 2.0 | 50.0 |
| 3 | 2.5 | 50.0 |
| 4 | 3.2 | 50.0 |
| 5 | 4.0 | 50.0 |
| 6 | 5.0 | 50.0 |
| 7 | 6.3 | 50.0 |
| 8 | 8.0 | 50.0 |
| 9 | 10.0 | 50.2 |
| 10 | 12.5 | 51.0 |
| 11 | 16.0 | 62.2 |
| 12 | 20.0 | 65.1 |
| 13 | 25.0 | 80.0 |
| 14 | 31.5 | 69.1 |
| 15 | 40.0 | 79.4 |
| 16 | 50.0 | 94.5 |
| 17 | 63.0 | 79.4 |
| 18 | 80.0 | 86.0 |
| 19 | 100.0 | 88.5 |
| 20 | 125.0 | 89.3 |
| 21 | 160.0 | 82.4 |
| 22 | 200.0 | 81.7 |
| 23 | 250.0 | 76.7 |
| 24 | 315.0 | 75.1 |
| 25 | 400.0 | 72.1 |
| 26 | 500.0 | 72.0 |
| 27 | 630.0 | 72.3 |
| 28 | 800.0 | 76.4 |
| 29 | 1000.0 | 75.5 |
| 30 | 1250.0 | 73.3 |
| 31 | 1600.0 | 73.2 |
| 32 | 2000.0 | 74.0 |
| 33 | 2500.0 | 71.3 |
| 34 | 3150.0 | 70.9 |
| 35 | 4000.0 | 69.8 |
| 36 | 5000.0 | 68.8 |
| 37 | 6300.0 | 68.3 |
| 38 | 8000.0 | 74.5 |
| 39 | 10000.0 | 64.2 |
| 40 | 12500.0 | 59.1 |
| 41 | 16000.0 | 56.9 |
| 42 | 20000.0 | 49.3 |

A WEIGHTED LEVEL 85.2dB

100




Tape#4;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N7 ;Aux Load=Full

Turbo In Cone Rem;78/08/23;1230hr

Mic Pos=100ft

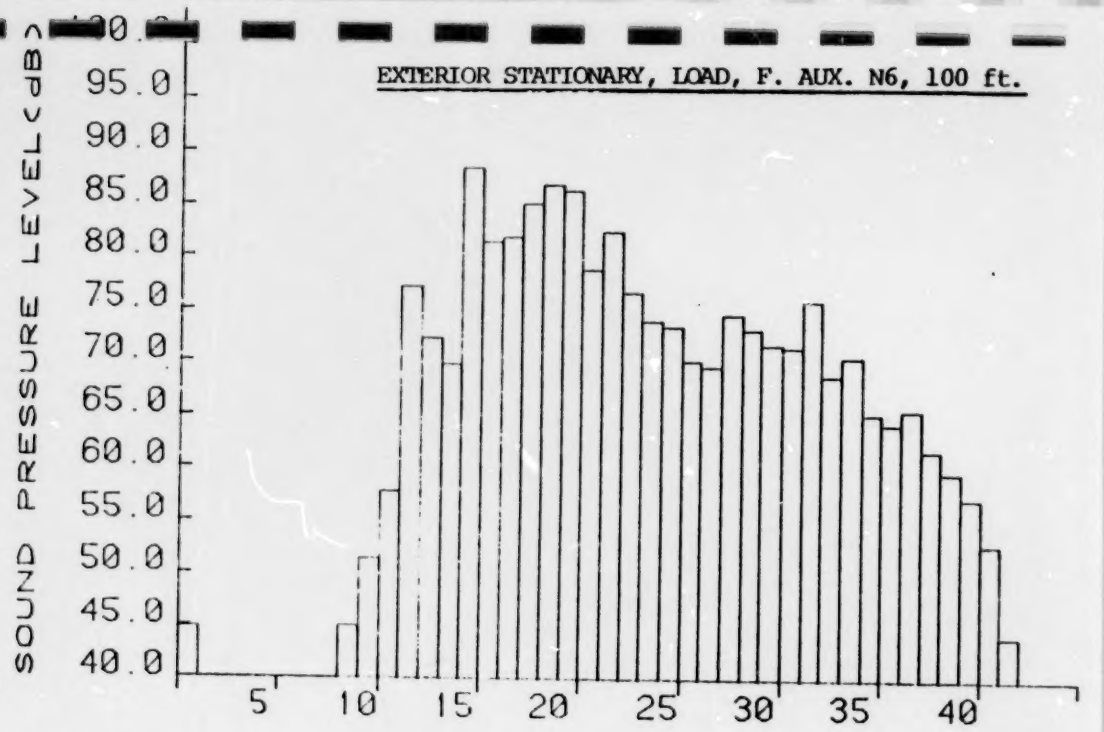
Att:2209=90,Nagra=40

Wind=600gt800 fpm from N.

FIG. 73

| CH. | EQ (Hz) | LEVEL (dB) |
|---|---|---|
| 1 | 1.6 | 44.8 |
| 2 | 2.0 | 40.0 |
| 3 | 2.5 | 40.0 |
| 4 | 3.2 | 40.0 |
| 5 | 4.0 | 40.0 |
| 6 | 5.0 | 40.0 |
| 7 | 6.3 | 40.0 |
| 8 | 8.0 | 40.0 |
| 9 | 10.0 | 45.0 |
| 10 | 12.5 | 51.4 |
| 11 | 16.0 | 57.9 |
| 12 | 20.0 | 77.3 |
| 13 | 25.0 | 72.4 |
| 14 | 31.5 | 69.9 |
| 15 | 40.0 | 88.7 |
| 16 | 50.0 | 81.6 |
| 17 | 63.0 | 82.1 |
| 18 | 80.0 | 85.3 |
| 19 | 100.0 | 87.1 |
| 20 | 125.0 | 86.6 |
| 21 | 160.0 | 79.0 |
| 22 | 200.0 | 82.7 |
| 23 | 250.0 | 76.8 |
| 24 | 315.0 | 74.1 |
| 25 | 400.0 | 73.6 |
| 26 | 500.0 | 70.3 |
| 27 | 630.0 | 69.8 |
| 28 | 800.0 | 74.7 |
| 29 | 1000.0 | 73.3 |
| 30 | 1250.0 | 71.8 |
| 31 | 1600.0 | 71.7 |
| 32 | 2000.0 | 76.0 |
| 33 | 2500.0 | 68.8 |
| 34 | 3150.0 | 70.7 |
| 35 | 4000.0 | 65.3 |
| 36 | 5000.0 | 64.3 |
| 37 | 6300.0 | 55.7 |
| 38 | 8000.0 | 61.9 |
| 39 | 10000.0 | 59.8 |
| 40 | 12500.0 | 57.3 |
| 41 | 16000.0 | 53.0 |
| 42 | 20000.0 | 44.1 |

A WEIGHTED LEVEL 83.8dB




Tape#4;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N6 ;Aux Load=Full

Turbo In Cone Rem;78/08/23;1230hr

Mic Pos=100ft

Att:2209=90,Nagra=40

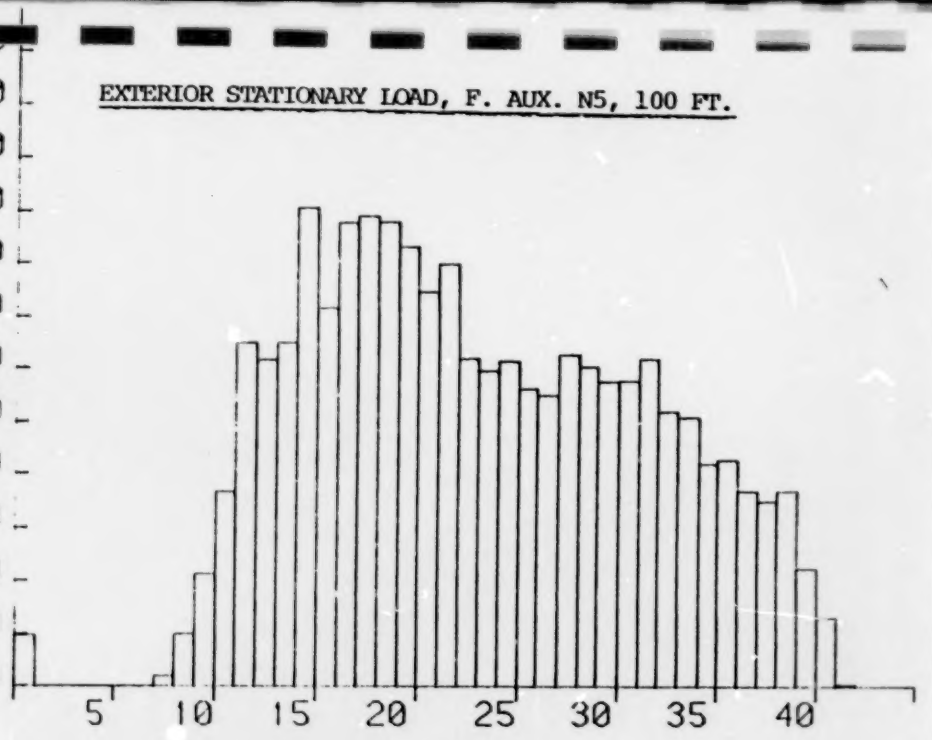
Wind=600gt800 fpm from N.



FIG. 74

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 44.8 |
| 2 | 2.0 | 40.0 |
| 3 | 2.5 | 40.0 |
| 4 | 3.2 | 40.0 |
| 5 | 4.0 | 40.0 |
| 6 | 5.0 | 40.0 |
| 7 | 6.3 | 40.0 |
| 8 | 8.0 | 41.0 |
| 9 | 10.0 | 45.0 |
| 10 | 12.5 | 50.6 |
| 11 | 16.0 | 58.4 |
| 12 | 20.0 | 72.5 |
| 13 | 25.0 | 71.0 |
| 14 | 31.5 | 72.5 |
| 15 | 40.0 | 85.4 |
| 16 | 50.0 | 75.9 |
| 17 | 63.0 | 84.0 |
| 18 | 80.0 | 84.6 |
| 19 | 100.0 | 84.1 |
| 20 | 125.0 | 81.7 |
| 21 | 160.0 | 77.5 |
| 22 | 200.0 | 80.1 |
| 23 | 250.0 | 71.1 |
| 24 | 315.0 | 69.9 |
| 25 | 400.0 | 70.8 |
| 26 | 500.0 | 68.2 |
| 27 | 630.0 | 67.6 |
| 28 | 800.0 | 71.5 |
| 29 | 1000.0 | 70.3 |
| 30 | 1250.0 | 68.8 |
| 31 | 1600.0 | 69.0 |
| 32 | 2000.0 | 71.1 |
| 33 | 2500.0 | 66.0 |
| 34 | 3150.0 | 65.5 |
| 35 | 4000.0 | 61.1 |
| 36 | 5000.0 | 61.5 |
| 37 | 6300.0 | 58.5 |
| 38 | 8000.0 | 57.6 |
| 39 | 10000.0 | 58.4 |
| 40 | 12500.0 | 51.2 |
| 41 | 16000.0 | 46.5 |
| 42 | 20000.0 | 40.3 |

A WEIGHTED LEVEL 80.3dB




Tape#4;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N5 ;Aux Load=Full

Turbo In Cone Rem;78/08/23;1230hr

Mic Pos=100ft

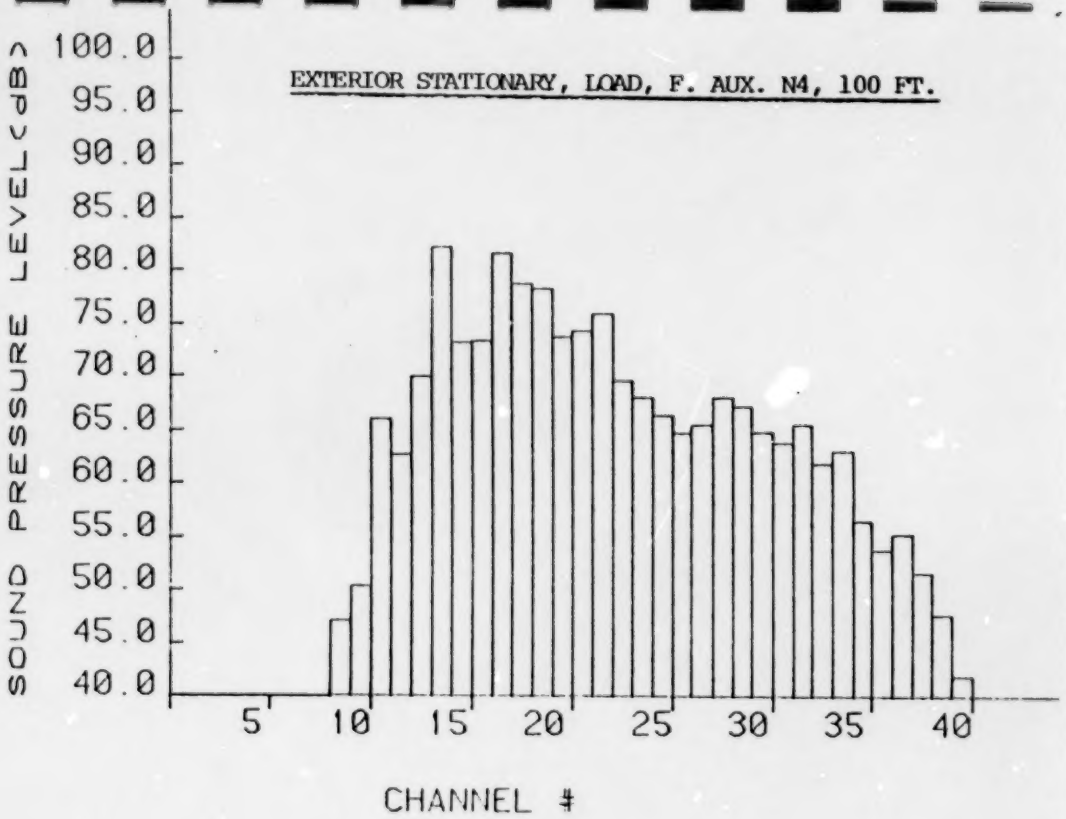
Att:2209=90,Nagra=40

Wind=600gt800 fpm from N.

FIG. 75

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 40.0 |
| 2 | 2.0 | 40.0 |
| 3 | 2.5 | 40.0 |
| 4 | 3.2 | 40.0 |
| 5 | 4.0 | 40.0 |
| 6 | 5.0 | 40.0 |
| 7 | 6.3 | 40.0 |
| 8 | 8.0 | 40.0 |
| 9 | 10.0 | 47.2 |
| 10 | 12.5 | 50.4 |
| 11 | 16.0 | 66.2 |
| 12 | 20.0 | 62.7 |
| 13 | 25.0 | 70.1 |
| 14 | 31.5 | 82.4 |
| 15 | 40.0 | 73.5 |
| 16 | 50.0 | 73.6 |
| 17 | 63.0 | 81.8 |
| 18 | 80.0 | 79.0 |
| 19 | 100.0 | 78.5 |
| 20 | 125.0 | 73.9 |
| 21 | 160.0 | 74.4 |
| 22 | 200.0 | 76.2 |
| 23 | 250.0 | 69.8 |
| 24 | 315.0 | 68.2 |
| 25 | 400.0 | 66.5 |
| 26 | 500.0 | 64.8 |
| 27 | 630.0 | 65.6 |
| 28 | 800.0 | 68.2 |
| 29 | 1000.0 | 67.4 |
| 30 | 1250.0 | 64.9 |
| 31 | 1600.0 | 64.0 |
| 32 | 2000.0 | 65.7 |
| 33 | 2500.0 | 62.0 |
| 34 | 3150.0 | 63.2 |
| 35 | 4000.0 | 56.7 |
| 36 | 5000.0 | 54.0 |
| 37 | 6300.0 | 55.4 |
| 38 | 8000.0 | 51.8 |
| 39 | 10000.0 | 47.8 |
| 40 | 12500.0 | 42.0 |
| 41 | 16000.0 | 39.5 |
| 42 | 20000.0 | 39.3 |

A WEIGHTED LEVEL 76.4dB




Tape#4;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N4 ;Aux Load=Full

Turbo In Cone Rem;78/08/23;1230hr

Mic Pos=100ft

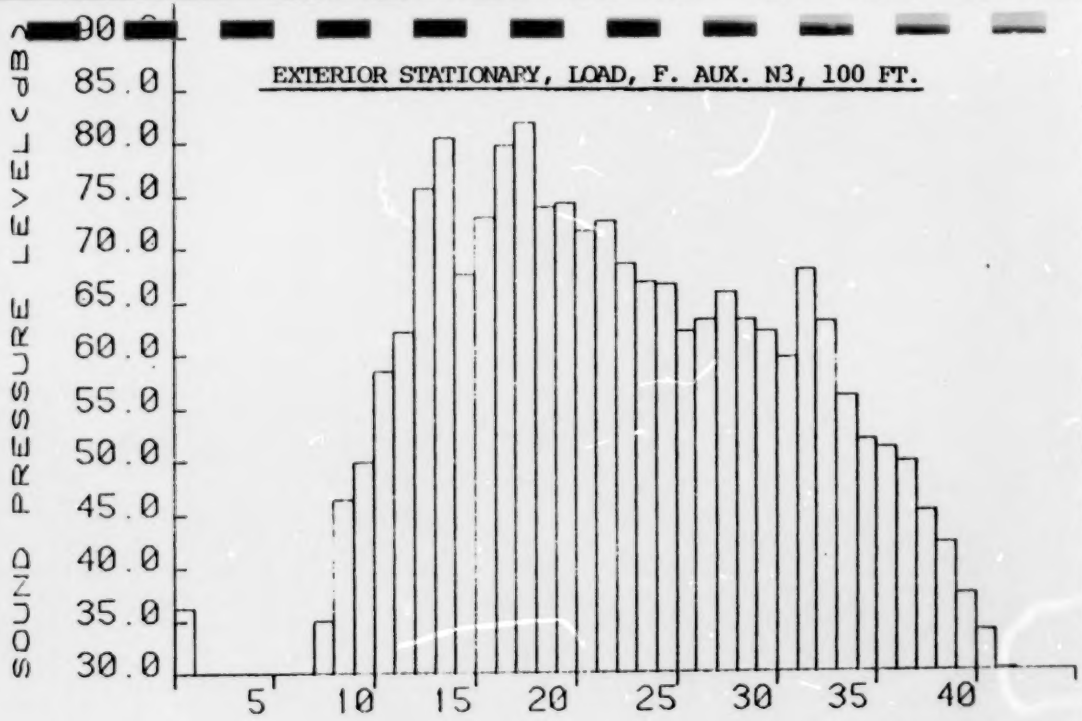
Att:2209=80,Nagra=40

Wind=600gt800 fpm from N.

FIG. 76

| CH[redacted]. | [redacted]EO[redacted]z) | LE[redacted]L([redacted]) |
|---|---|---|
| 1 | 1.6 | 36.3 |
| 2 | 2.0 | 30.0 |
| 3 | 2.5 | 30.0 |
| 4 | 3.2 | 30.0 |
| 5 | 4.0 | 30.0 |
| 6 | 5.0 | 30.0 |
| 7 | 6.3 | 30.0 |
| 8 | 8.0 | 35.1 |
| 9 | 10.0 | 46.4 |
| 10 | 12.5 | 49.9 |
| 11 | 16.0 | 58.5 |
| 12 | 20.0 | 62.2 |
| 13 | 25.0 | 75.8 |
| 14 | 31.5 | 80.5 |
| 15 | 40.0 | 67.7 |
| 16 | 50.0 | 73.1 |
| 17 | 63.0 | 79.8 |
| 18 | 80.0 | 81.9 |
| 19 | 100.0 | 73.9 |
| 20 | 125.0 | 74.3 |
| 21 | 160.0 | 71.7 |
| 22 | 200.0 | 72.7 |
| 23 | 250.0 | 68.6 |
| 24 | 315.0 | 66.9 |
| 25 | 400.0 | 66.7 |
| 26 | 500.0 | 62.3 |
| 27 | 630.0 | 63.3 |
| 28 | 800.0 | 65.9 |
| 29 | 1000.0 | 63.3 |
| 30 | 1250.0 | 62.2 |
| 31 | 1600.0 | 59.8 |
| 32 | 2000.0 | 68.2 |
| 33 | 2500.0 | 63.1 |
| 34 | 3150.0 | 56.2 |
| 35 | 4000.0 | 52.0 |
| 36 | 5000.0 | 51.3 |
| 37 | 6300.0 | 49.9 |
| 38 | 8000.0 | 45.3 |
| 39 | 10000.0 | 42.2 |
| 40 | 12500.0 | 37.4 |
| 41 | 16000.0 | 33.9 |
| 42 | 20000.0 | 30.3 |

A WEIGHTED LEVEL 74.9dB




Tape#4;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N3 ;Aux Load=Full

Turbo In Cone Rem;78/08/23;1230hr

Mic Pos=100ft

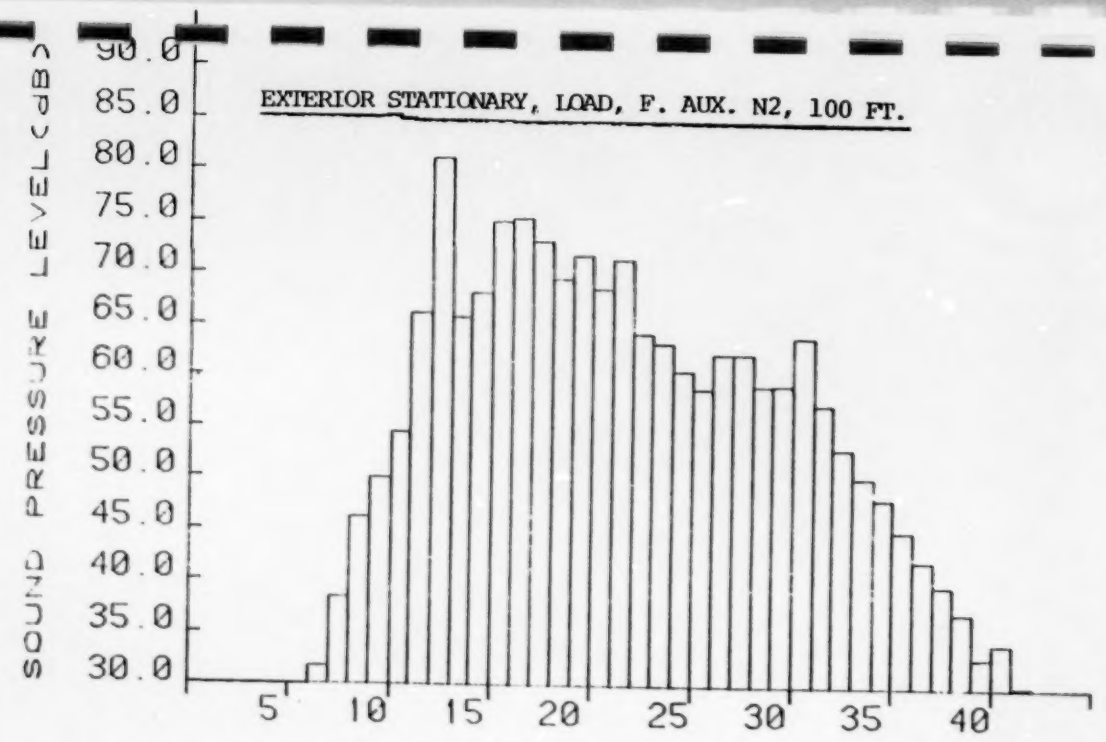
Att:2209=80,Nagra=40

Wind=600gt800 fpm from N.

FIG. 77

| CH. #. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 30.0 |
| 2 | 2.0 | 30.0 |
| 3 | 2.5 | 30.0 |
| 4 | 3.2 | 30.0 |
| 5 | 4.0 | 30.0 |
| 6 | 5.0 | 30.0 |
| 7 | 6.3 | 31.8 |
| 8 | 8.0 | 38.4 |
| 9 | 10.0 | 46.2 |
| 10 | 12.5 | 50.0 |
| 11 | 16.0 | 54.5 |
| 12 | 20.0 | 66.2 |
| 13 | 25.0 | 81.2 |
| 14 | 31.5 | 65.8 |
| 15 | 40.0 | 68.1 |
| 16 | 50.0 | 75.1 |
| 17 | 63.0 | 75.4 |
| 18 | 80.0 | 73.2 |
| 19 | 100.0 | 69.5 |
| 20 | 125.0 | 71.8 |
| 21 | 160.0 | 68.6 |
| 22 | 200.0 | 71.5 |
| 23 | 250.0 | 64.2 |
| 24 | 315.0 | 63.3 |
| 25 | 400.0 | 60.5 |
| 26 | 500.0 | 58.8 |
| 27 | 630.0 | 62.3 |
| 28 | 800.0 | 62.2 |
| 29 | 1000.0 | 59.2 |
| 30 | 1250.0 | 59.2 |
| 31 | 1600.0 | 64.0 |
| 32 | 2000.0 | 57.3 |
| 33 | 2500.0 | 53.0 |
| 34 | 3150.0 | 50.3 |
| 35 | 4000.0 | 48.3 |
| 36 | 5000.0 | 45.1 |
| 37 | 6300.0 | 42.3 |
| 38 | 8000.0 | 39.9 |
| 39 | 10000:0 | 37.3 |
| 40 | 12500.0 | 33.1 |
| 41 | 16000.0 | 34.3 |
| 42 | 20000.0 | 30.3 |

A WEIGHTED LEVEL 70.9dB




Tape#4;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N2 ;Aux Load=Full

Turbo In Cone Rem;78/08/23;1230hr

Mic Pos=100ft

Att:2209=80,Nagra=40

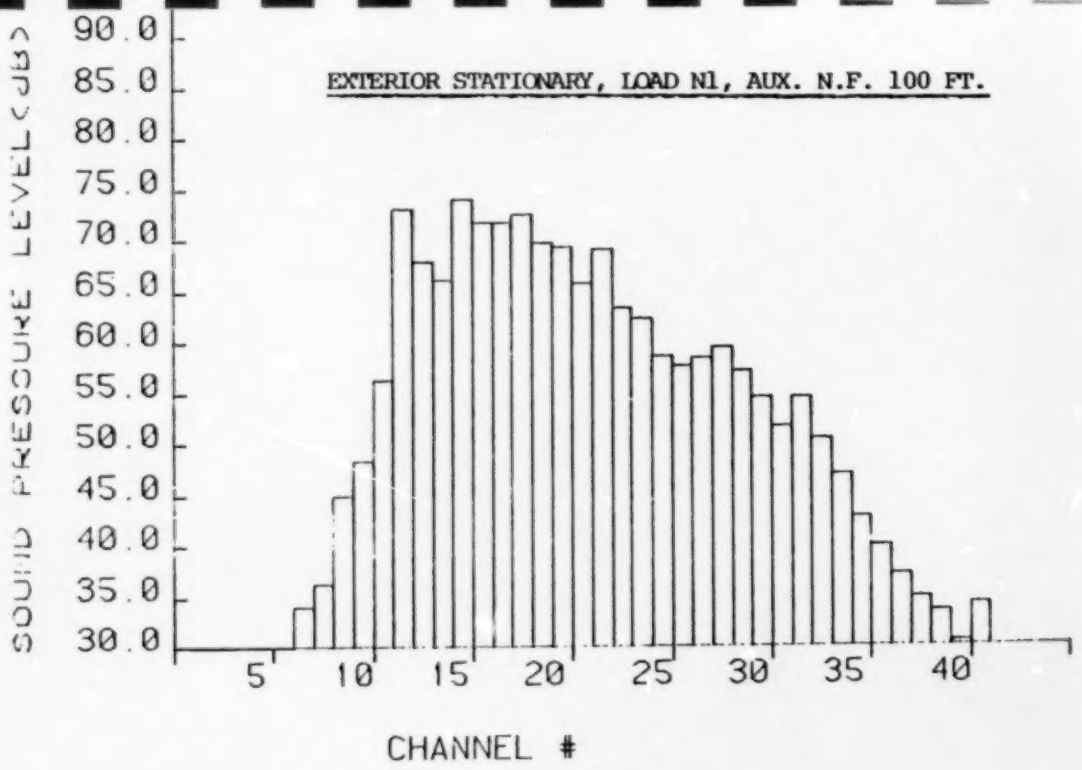
Wind=600gt800 fpm from N.



FIG. 78

| CH #. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 30.0 |
| 2 | 2.0 | 30.0 |
| 3 | 2.5 | 30.0 |
| 4 | 3.2 | 30.0 |
| 5 | 4.0 | 30.0 |
| 6 | 5.0 | 30.0 |
| 7 | 6.3 | 34.0 |
| 8 | 8.0 | 36.3 |
| 9 | 10.0 | 44.9 |
| 10 | 12.5 | 48.3 |
| 11 | 16.0 | 56.3 |
| 12 | 20.0 | 73.2 |
| 13 | 25.0 | 68.0 |
| 14 | 31.5 | 66.2 |
| 15 | 40.0 | 74.1 |
| 16 | 50.0 | 71.9 |
| 17 | 63.0 | 71.8 |
| 18 | 80.0 | 72.7 |
| 19 | 100.0 | 69.8 |
| 20 | 125.0 | 69.4 |
| 21 | 160.0 | 65.9 |
| 22 | 200.0 | 69.2 |
| 23 | 250.0 | 63.5 |
| 24 | 315.0 | 62.4 |
| 25 | 400.0 | 58.6 |
| 26 | 500.0 | 57.7 |
| 27 | 630.0 | 58.5 |
| 28 | 800.0 | 59.5 |
| 29 | 1000.0 | 57.2 |
| 30 | 1250.0 | 54.6 |
| 31 | 1600.0 | 51.8 |
| 32 | 2000.0 | 54.6 |
| 33 | 2500.0 | 50.5 |
| 34 | 3150.0 | 47.1 |
| 35 | 4000.0 | 42.9 |
| 36 | 5000.0 | 40.1 |
| 37 | 6300.0 | 37.2 |
| 38 | 8000.0 | 35.0 |
| 39 | 10000.0 | 33.5 |
| 40 | 12500.0 | 30.6 |
| 41 | 16000.0 | 34.3 |
| 42 | 20000.0 | 29.3 |

A WEIGHTED LEVEL 67.3dB




Tape#4;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=N1 ;Aux Load

Turbo In Cone Rem;78/08/23;1230hr

Mic Pos=100ft

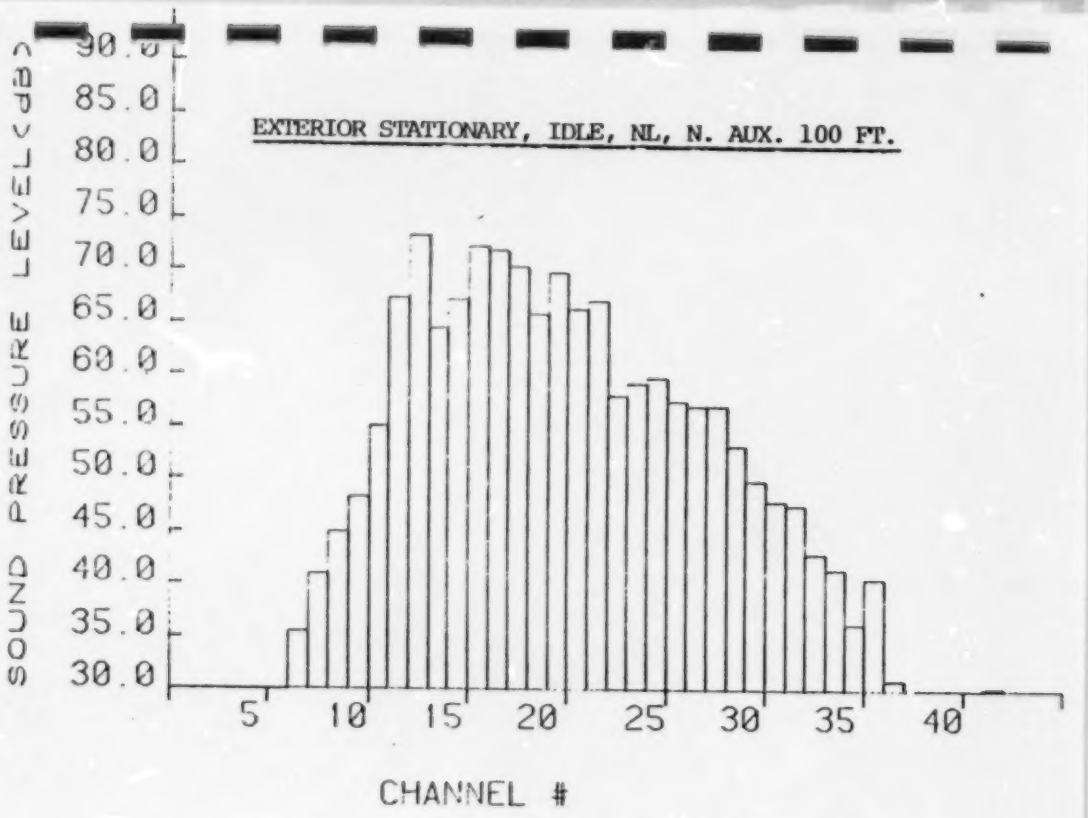
Att:2209=80,Nagra=40

Wind=600gt800 fpm from N.

FIG. 79

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 30.0 |
| 2 | 2.0 | 30.0 |
| 3 | 2.5 | 30.0 |
| 4 | 3.2 | 30.0 |
| 5 | 4.0 | 30.0 |
| 6 | 5.0 | 30.0 |
| 7 | 6.3 | 35.4 |
| 8 | 8.0 | 40.9 |
| 9 | 10.0 | 44.9 |
| 10 | 12.5 | 48.3 |
| 11 | 16.0 | 55.1 |
| 12 | 20.0 | 67.4 |
| 13 | 25.0 | 73.4 |
| 14 | 31.5 | 64.6 |
| 15 | 40.0 | 67.4 |
| 16 | 50.0 | 72.4 |
| 17 | 63.0 | 72.0 |
| 18 | 80.0 | 70.5 |
| 19 | 100.0 | 65.9 |
| 20 | 125.0 | 69.9 |
| 21 | 160.0 | 66.4 |
| 22 | 200.0 | 67.2 |
| 23 | 250.0 | 58.1 |
| 24 | 315.0 | 59.3 |
| 25 | 400.0 | 59.8 |
| 26 | 500.0 | 57.5 |
| 27 | 630.0 | 57.0 |
| 28 | 800.0 | 57.0 |
| 29 | 1000.0 | 53.3 |
| 30 | 1250.0 | 49.9 |
| 31 | 1600.0 | 48.0 |
| 32 | 2000.0 | 47.6 |
| 33 | 2500.0 | 42.9 |
| 34 | 3150.0 | 41.5 |
| 35 | 4000.0 | 36.3 |
| 36 | 5000.0 | 40.6 |
| 37 | 6300.0 | 30.9 |
| 38 | 8000.0 | 29.3 |
| 39 | 10000.0 | 29.5 |
| 40 | 12500.0 | 29.6 |
| 41 | 16000.0 | 29.5 |
| 42 | 20000.0 | 30.3 |

A WEIGHTED LEVEL 65.0dB




Tape#1;Noise Levels;Avg:Lin 16s

Loco#2534;Eng Speed=Idle;

Hotel Load=Nil ;78/08/15;1600hr

Mic Ht=5ft;Mic Pos=100ft/LHS

Att:2209=80,Nagra=40;Temp=45 C

Wind=600gt800 fpm from N.



FIG. 80

# STATIONARY EXTERIOR NOISE(IDLE,NO AUX,NO HOTEL LOAD (* CORRECTED FOR BACKGROUND NOISE)

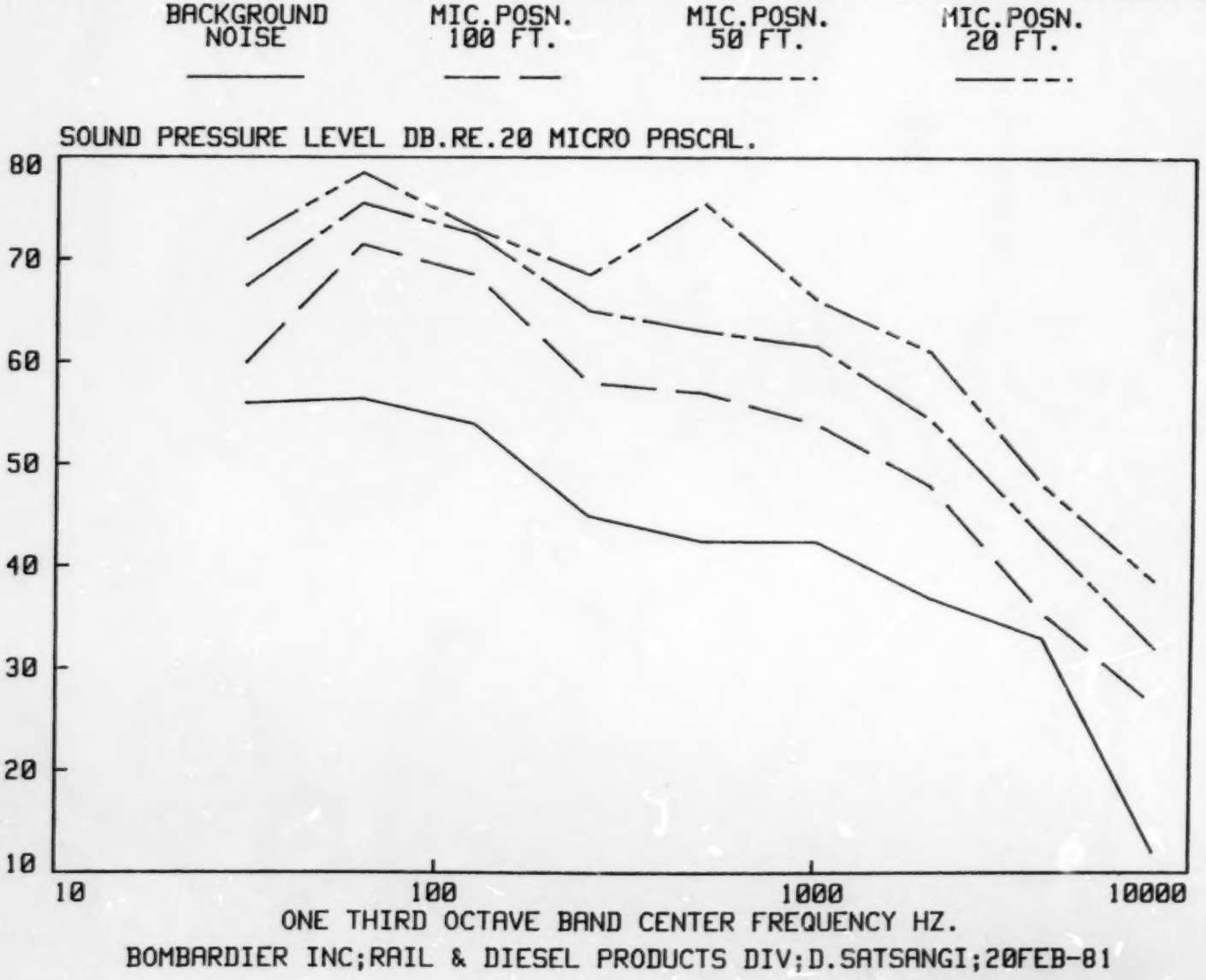



FIG. 81

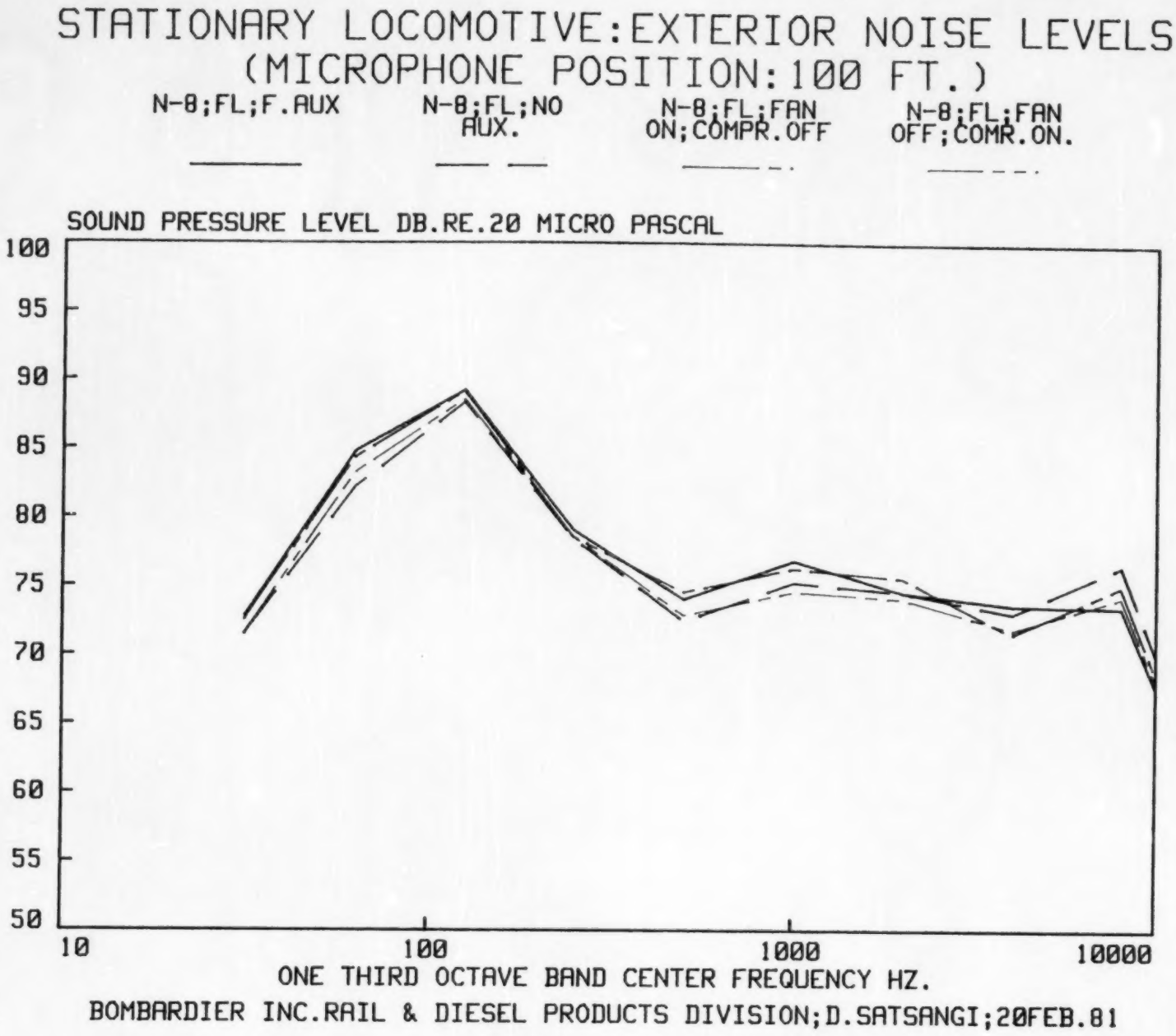

STATIONARY LOCOMOTIVE:EXTERIOR NOISE LEVELS
(MICROPHONE POSITION:100 FT.)
N-8;FL;F.AUX
N-8;FL;NO AUX.
N-8;FL;FAN ON;COMPR.OFF
N-8;FL;FAN OFF;COMR.ON.
SOUND PRESSURE LEVEL DB.RE.20 MICRO PASCAL
100
95
90
85
80
75
70
65
60
55
50
10
100
1000
10000
ONE THIRD OCTAVE BAND CENTER FREQUENCY HZ.
BOMBARDIER INC.RAIL & DIESEL PRODUCTS DIVISION;D.SATSANGI;20FEB.81

FIG. 82

# STATIONARY EXTERIOR NOISE LEVELS AT 100 FEET.

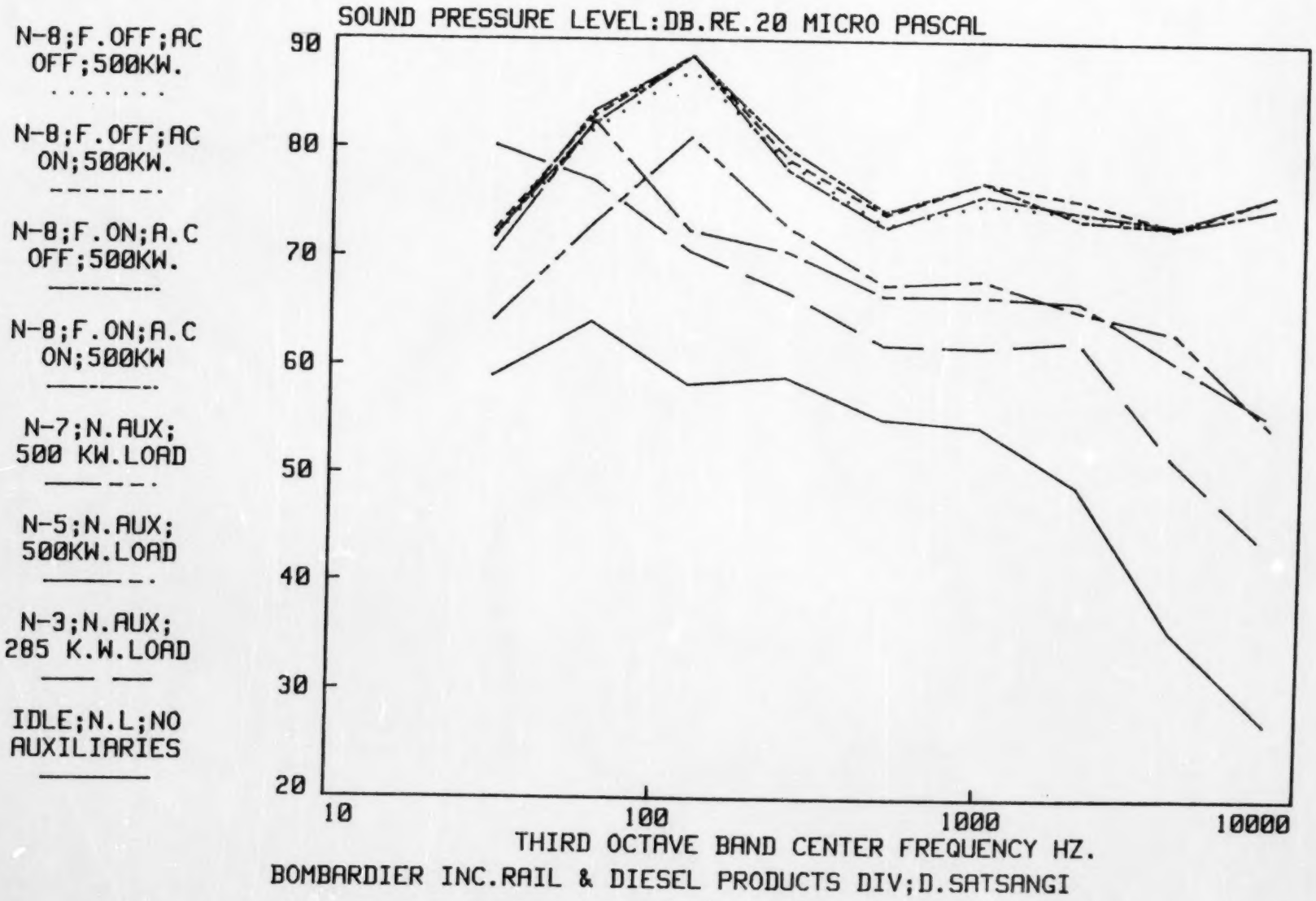
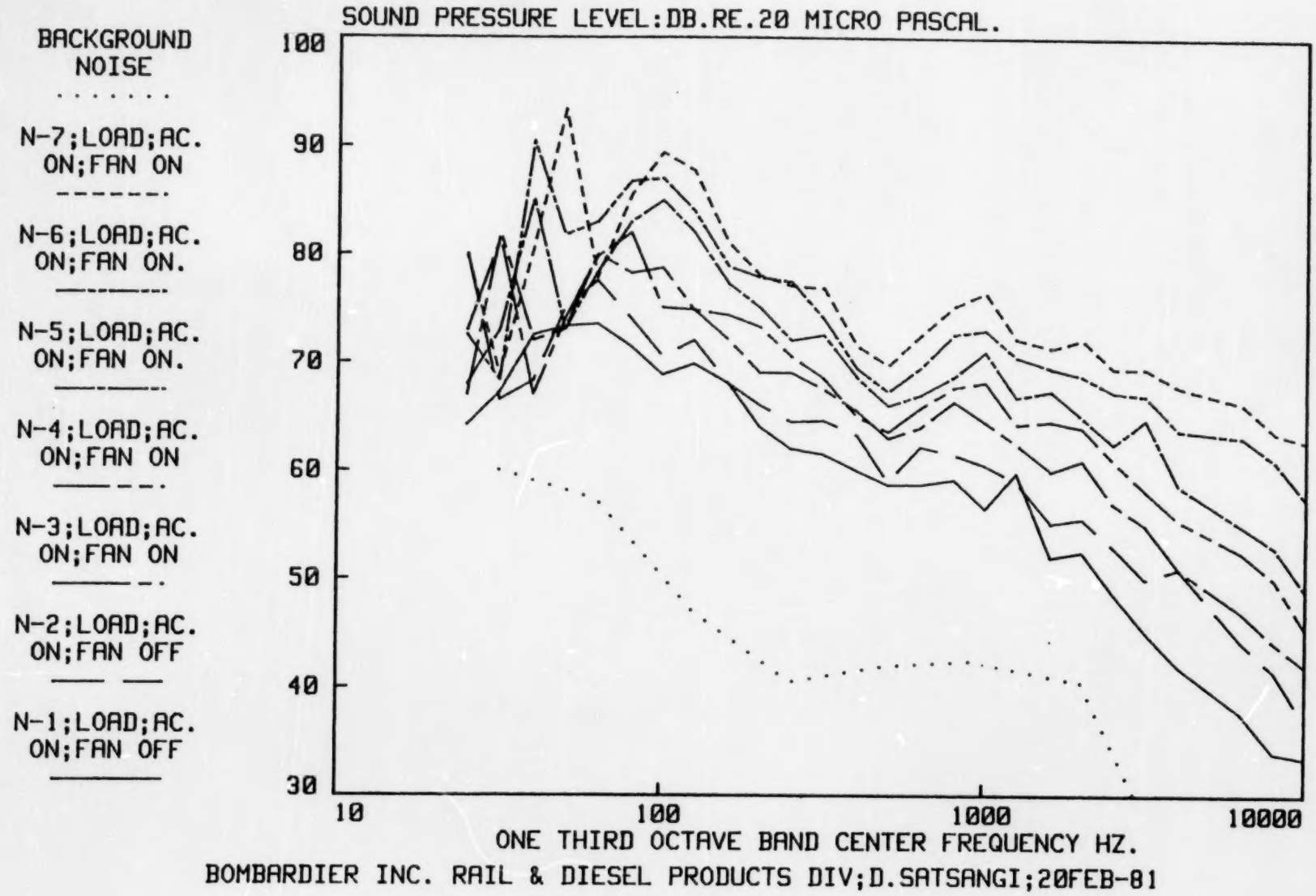



FIG. 83

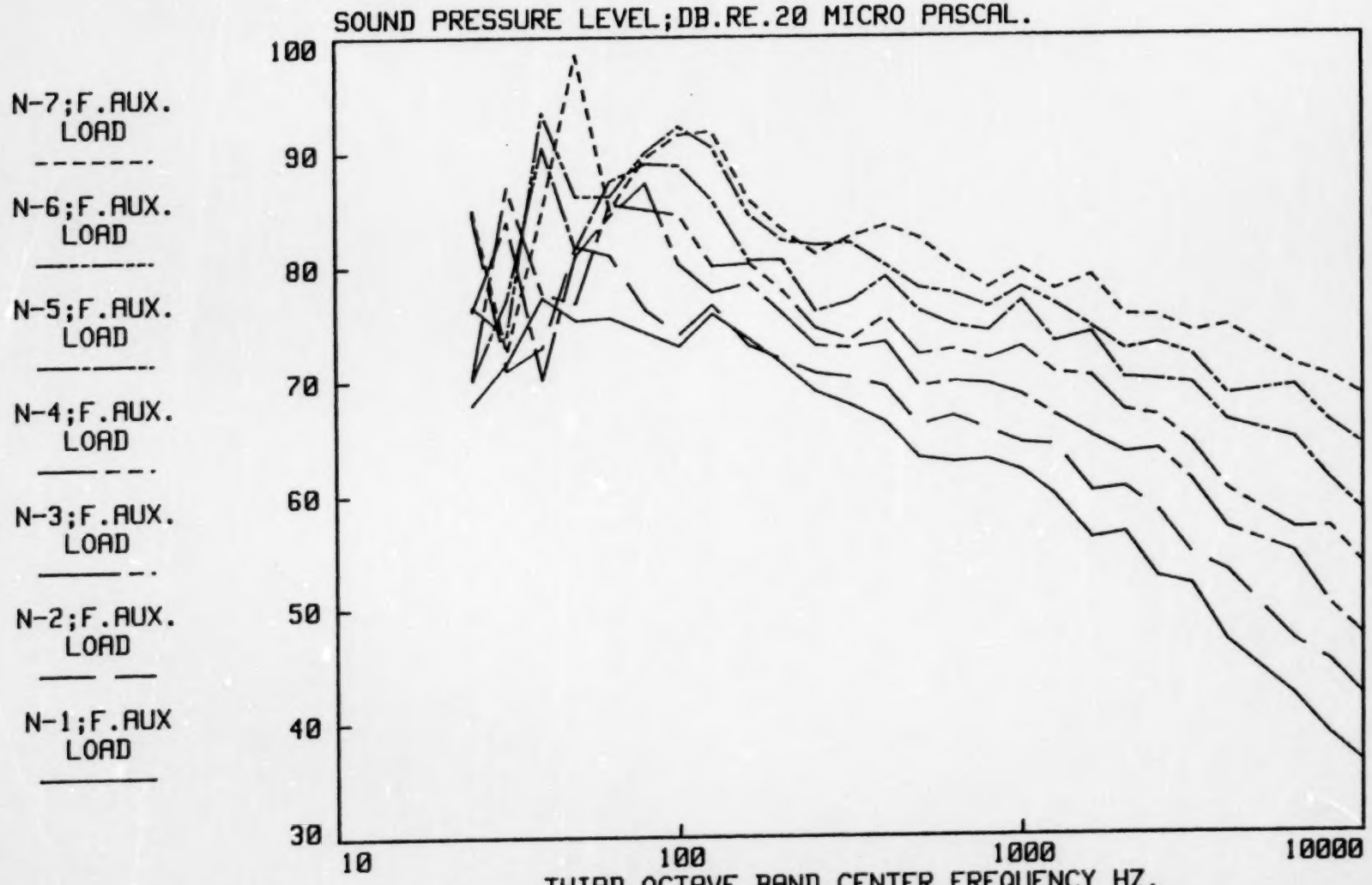
# STATIONARY EXTERIOR NOISE LEVELS AT 100 FEET.
# (AT VARIOUS THROTTLE SETTINGS & RATED LOADS)




BOMBARDIER INC. RAIL & DIESEL PRODUCTS DIV;D.SATSANGI;20FEB-81

FIG. 84

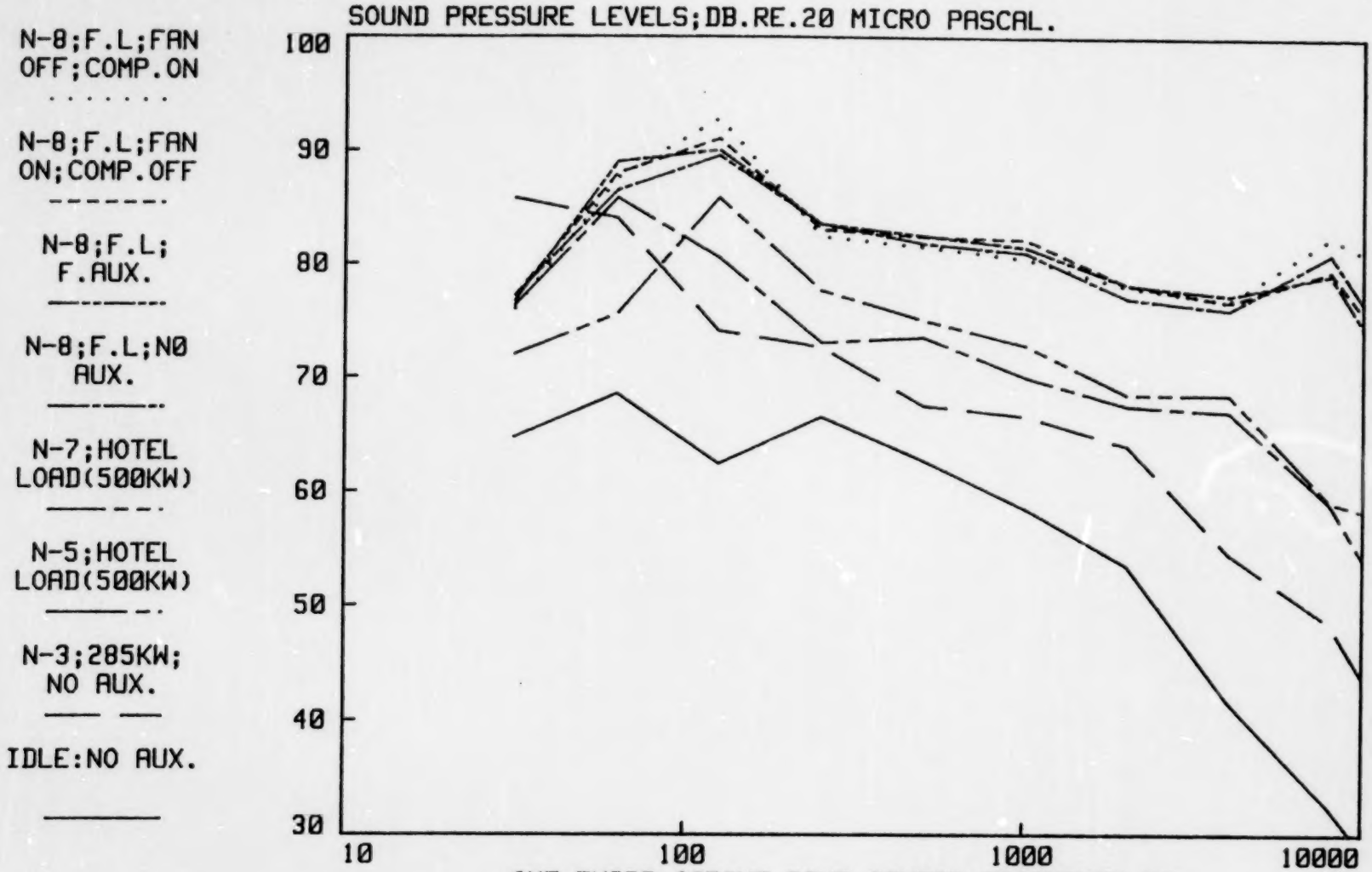
# STATIONARY LOCOMOTIVE:EXTERIOR NOISE LEVELS
# MICROPHONE POSITION 50 FT.




BOMBARDIER INC.RAIL & DIESEL PRODUCTS DIVISION;D.SATSANGI;20 FEB-81

FIG. 85

# STATIONARY EXTERIER NOISE LEVELS AT 50 FEET.
# (MEASURED AT DIFFERENT LOAD AND ENGINE SPEED)

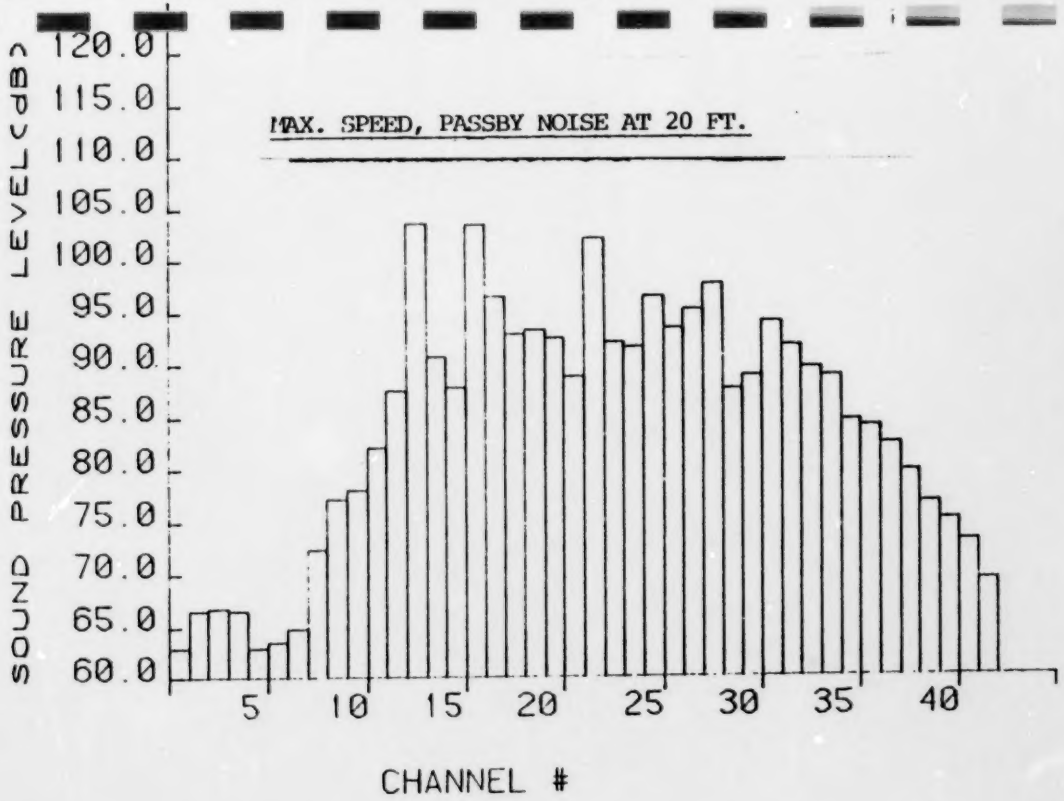



BOMBARDIER INC;RAIL & DIESEL PRODUCTS DIVISION;D.SATSANGI;20FEB-81

FIG. 86

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 63.0 |
| 2 | 2.0 | 66.5 |
| 3 | 2.5 | 66.7 |
| 4 | 3.2 | 66.5 |
| 5 | 4.0 | 63.0 |
| 6 | 5.0 | 63.5 |
| 7 | 6.3 | 64.8 |
| 8 | 8.0 | 72.4 |
| 9 | 10.0 | 77.2 |
| 10 | 12.5 | 78.1 |
| 11 | 16.0 | 82.1 |
| 12 | 20.0 | 87.5 |
| 13 | 25.0 | 103.7 |
| 14 | 31.5 | 90.8 |
| 15 | 40.0 | 87.9 |
| 16 | 50.0 | 103.6 |
| 17 | 63.0 | 96.6 |
| 18 | 80.0 | 93.1 |
| 19 | 100.0 | 93.4 |
| 20 | 125.0 | 92.6 |
| 21 | 160.0 | 88.9 |
| 22 | 200.0 | 102.3 |
| 23 | 250.0 | 92.3 |
| 24 | 315.0 | 91.7 |
| 25 | 400.0 | 96.7 |
| 26 | 500.0 | 93.5 |
| 27 | 630.0 | 95.3 |
| 28 | 800.0 | 97.8 |
| 29 | 1000.0 | 87.7 |
| 30 | 1250.0 | 89.0 |
| 31 | 1600.0 | 94.3 |
| 32 | 2000.0 | 91.9 |
| 33 | 2500.0 | 89.8 |
| 34 | 3150.0 | 89.1 |
| 35 | 4000.0 | 84.8 |
| 36 | 5000.0 | 84.2 |
| 37 | 6300.0 | 82.6 |
| 38 | 8000.0 | 80.0 |
| 39 | 10000.0 | 76.9 |
| 40 | 12500.0 | 75.2 |
| 41 | 16000.0 | 73.1 |
| 42 | 20000.0 | 69.3 |

A WEIGHTED LEVEL 103.4dB




Tape#12;Noise Levels

Loco#2534;Eng:N8,65mph;Aux Load=Full

Hotel Load=Full;78/08/26;1100hr

Mic Ht=4ft;Mic Pos=20 Ft/Trk CL;Passby

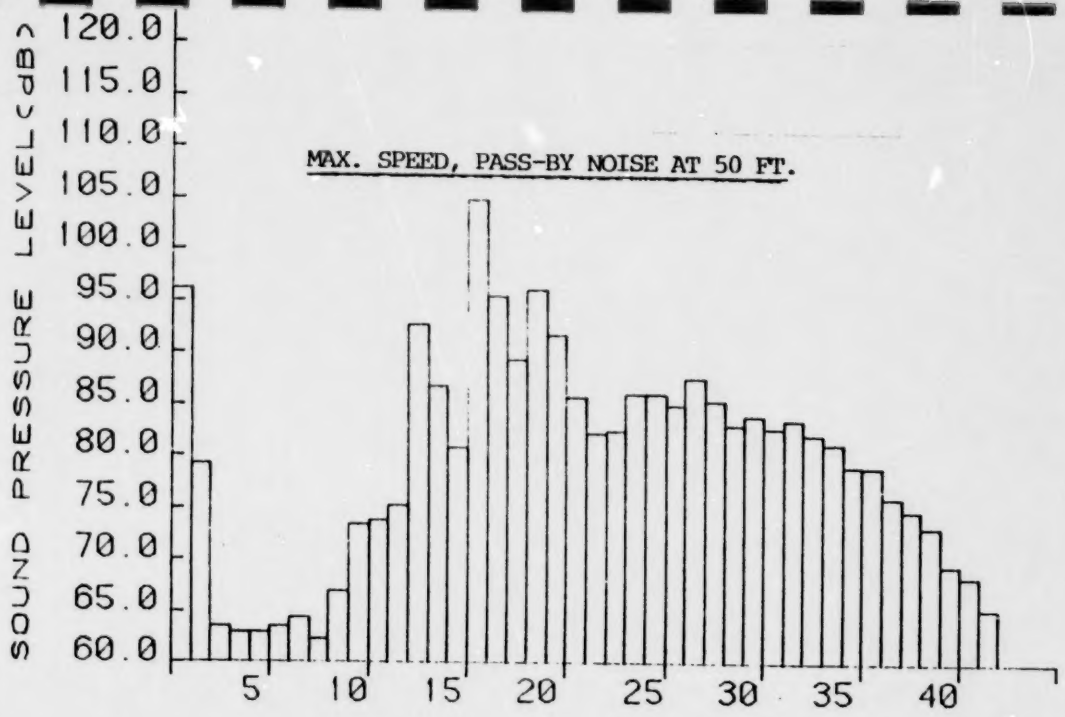
Att:2209=110,Nagra=40;Temp=22 C

Wind=600gt800 fpm from N.;Avg:Exp1/8,Max

FIG. 87

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 96.1 |
| 2 | 2.0 | 79.2 |
| 3 | 2.5 | 63.5 |
| 4 | 3.2 | 63.0 |
| 5 | 4.0 | 63.0 |
| 6 | 5.0 | 63.5 |
| 7 | 6.3 | 64.4 |
| 8 | 8.0 | 62.4 |
| 9 | 10.0 | 66.9 |
| 10 | 12.5 | 73.4 |
| 11 | 16.0 | 73.8 |
| 12 | 20.0 | 75.2 |
| 13 | 25.0 | 92.8 |
| 14 | 31.5 | 86.8 |
| 15 | 40.0 | 80.9 |
| 16 | 50.0 | 104.9 |
| 17 | 63.0 | 95.5 |
| 18 | 80.0 | 89.4 |
| 19 | 100.0 | 96.1 |
| 20 | 125.0 | 91.7 |
| 21 | 150.0 | 85.8 |
| 22 | 200.0 | 82.3 |
| 23 | 250.0 | 82.6 |
| 24 | 315.0 | 86.0 |
| 25 | 400.0 | 86.0 |
| 26 | 500.0 | 85.0 |
| 27 | 630.0 | 87.6 |
| 28 | 800.0 | 85.3 |
| 29 | 1000.0 | 83.0 |
| 30 | 1250.0 | 83.9 |
| 31 | 1600.0 | 82.8 |
| 32 | 2000.0 | 83.6 |
| 33 | 2500.0 | 82.1 |
| 34 | 3150.0 | 81.3 |
| 35 | 4000.0 | 79.2 |
| 36 | 5000.0 | 79.0 |
| 37 | 6300.0 | 76.2 |
| 38 | 8000.0 | 74.9 |
| 39 | 10000.0 | 73.2 |
| 40 | 12500.0 | 69.6 |
| 41 | 16000.0 | 68.5 |
| 42 | 20000.0 | 65.3 |

A WEIGHTED LEVEL 94.6dB




Tape#12;Noise Levels

Loco#2534;Eng:N8,Max mph;Aux Load=Full

Hotel Load=Full;78/08/26;1100hr

Mic Ht=4ft;Mic Pos=50Ft./Trk CL;Passby

Att:2209=100,Nagra=40;Temp=22 C

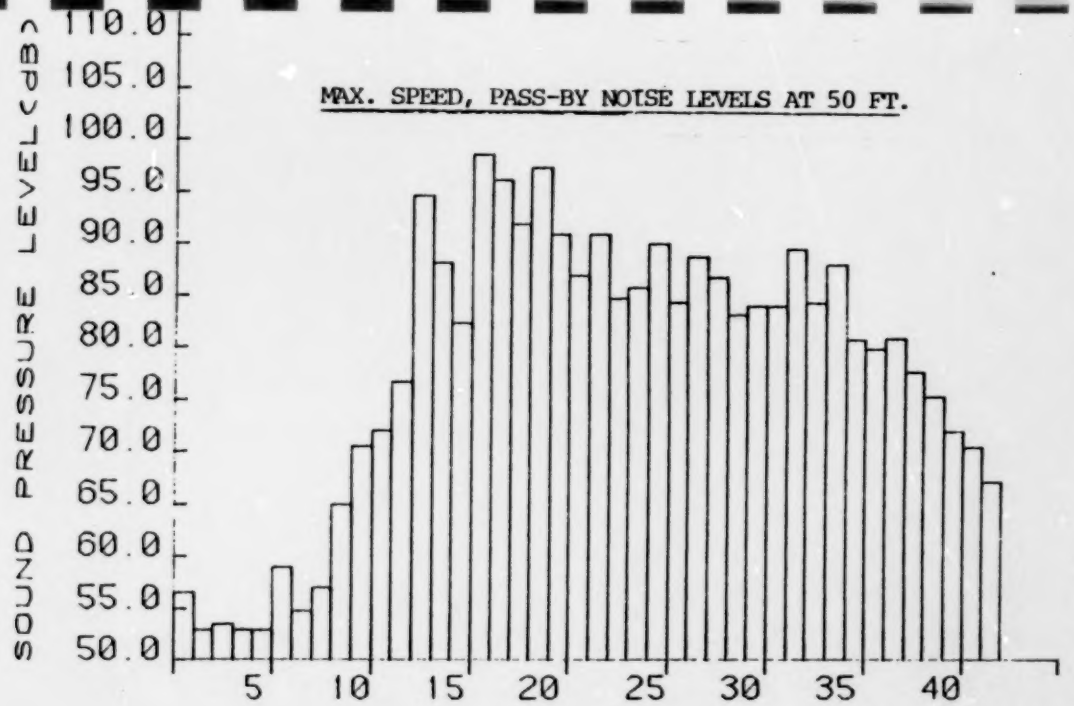
Wind=600gt800 fpm from N.;Avg:Exp1/8,Max



FIG. 88

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 56.5 |
| 2 | 2.0 | 53.0 |
| 3 | 2.5 | 53.5 |
| 4 | 3.2 | 53.0 |
| 5 | 4.0 | 53.0 |
| 6 | 5.0 | 59.0 |
| 7 | 6.3 | 54.8 |
| 8 | 8.0 | 57.0 |
| 9 | 10.0 | 64.9 |
| 10 | 12.5 | 70.6 |
| 11 | 16.0 | 72.0 |
| 12 | 20.0 | 76.7 |
| 13 | 25.0 | 94.7 |
| 14 | 31.5 | 88.2 |
| 15 | 40.0 | 82.4 |
| 16 | 50.0 | 98.8 |
| 17 | 63.0 | 96.3 |
| 18 | 80.0 | 92.1 |
| 19 | 100.0 | 97.5 |
| 20 | 125.0 | 91.0 |
| 21 | 160.0 | 86.9 |
| 22 | 200.0 | 91.0 |
| 23 | 250.0 | 84.7 |
| 24 | 315.0 | 85.8 |
| 25 | 400.0 | 90.0 |
| 26 | 500.0 | 84.3 |
| 27 | 630.0 | 88.7 |
| 28 | 800.0 | 86.8 |
| 29 | 1000.0 | 83.2 |
| 30 | 1250.0 | 84.1 |
| 31 | 1600.0 | 84.1 |
| 32 | 2000.0 | 89.6 |
| 33 | 2500.0 | 84.3 |
| 34 | 3150.0 | 88.1 |
| 35 | 4000.0 | 80.8 |
| 36 | 5000.0 | 80.0 |
| 37 | 6300.0 | 81.0 |
| 38 | 8000.0 | 77.7 |
| 39 | 10000.0 | 75.4 |
| 40 | 12500.0 | 72.0 |
| 41 | 16000.0 | 70.6 |
| 42 | 20000.0 | 67.2 |

A WEIGHTED LEVEL 97.3dB




Tape#12;Noise Levels

Loco#2534;Eng Speed=N8 ;Aux Load=Full

Hotel Load=Full;78/08/26;1100hr

Mic Ht=4ft;Mic Pos=50 Ft/Trk CL;Passby

Att:2209=100,Nagra=40;Temp=22 C

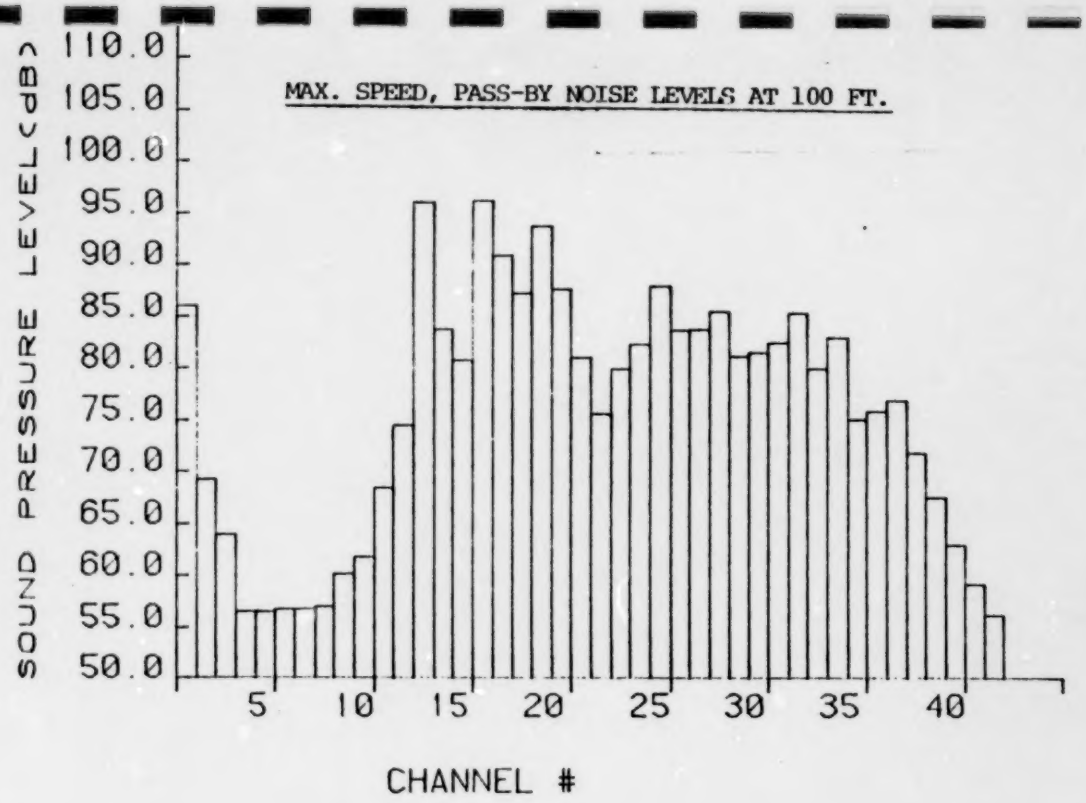
Wind=600gt800 fpm from N.;Avg:Exp1/8,Max



FIG. 89

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 86.0 |
| 2 | 2.0 | 69.2 |
| 3 | 2.5 | 63.9 |
| 4 | 3.2 | 56.5 |
| 5 | 4.0 | 56.5 |
| 6 | 5.0 | 56.7 |
| 7 | 6.3 | 56.7 |
| 8 | 8.0 | 57.0 |
| 9 | 10.0 | 60.1 |
| 10 | 12.5 | 61.8 |
| 11 | 16.0 | 68.5 |
| 12 | 20.0 | 74.4 |
| 13 | 25.0 | 96.1 |
| 14 | 31.5 | 83.8 |
| 15 | 40.0 | 80.9 |
| 16 | 50.0 | 96.3 |
| 17 | 63.0 | 91.0 |
| 18 | 80.0 | 87.3 |
| 19 | 100.0 | 93.8 |
| 20 | 125.0 | 87.7 |
| 21 | 160.0 | 81.1 |
| 22 | 200.0 | 75.7 |
| 23 | 250.0 | 80.1 |
| 24 | 315.0 | 82.4 |
| 25 | 400.0 | 87.9 |
| 26 | 500.0 | 83.7 |
| 27 | 630.0 | 83.8 |
| 28 | 800.0 | 85.5 |
| 29 | 1000.0 | 81.3 |
| 30 | 1250.0 | 81.6 |
| 31 | 1600.0 | 82.6 |
| 32 | 2000.0 | 85.4 |
| 33 | 2500.0 | 80.0 |
| 34 | 3150.0 | 83.1 |
| 35 | 4000.0 | 75.2 |
| 36 | 5000.0 | 75.9 |
| 37 | 6300.0 | 77.0 |
| 38 | 8000.0 | 71.9 |
| 39 | 10000.0 | 67.6 |
| 40 | 12500.0 | 63.0 |
| 41 | 16000.0 | 59.2 |
| 42 | 20000.0 | 56.3 |

A WEIGHTED LEVEL 93.8dB




Tape#12;Noise Levels

Loco#2534;Eng:N8,65mph;Aux Load=Full

Hotel Load=Full;78/08/26;1100hr

Mic Ht=4ft;Mic Pos:100Ft/Trk CL;Passby

Att:2209=90,Nagra=40;Temp=22 C

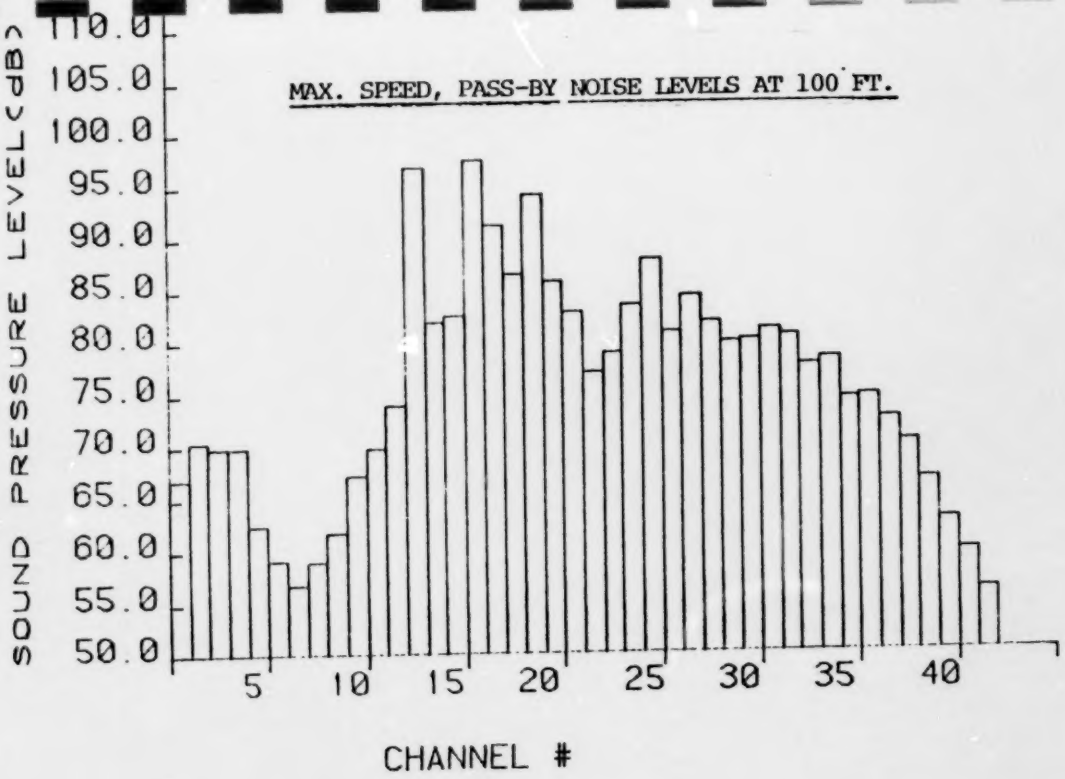
Wind=600gt800 fpm from N.;Avg:Exp1/8,Max



FIG. 90

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 66.9 |
| 2 | 2.0 | 70.4 |
| 3 | 2.5 | 69.9 |
| 4 | 3.2 | 69.9 |
| 5 | 4.0 | 62.5 |
| 6 | 5.0 | 59.1 |
| 7 | 6.3 | 56.7 |
| 8 | 8.0 | 59.0 |
| 9 | 10.0 | 61.7 |
| 10 | 12.5 | 67.2 |
| 11 | 16.0 | 69.8 |
| 12 | 20.0 | 73.9 |
| 13 | 25.0 | 96.9 |
| 14 | 31.5 | 82.0 |
| 15 | 40.0 | 82.7 |
| 16 | 50.0 | 97.6 |
| 17 | 63.0 | 91.4 |
| 18 | 80.0 | 86.7 |
| 19 | 100.0 | 94.3 |
| 20 | 125.0 | 85.9 |
| 21 | 160.0 | 82.9 |
| 22 | 200.0 | 77.1 |
| 23 | 250.0 | 79.1 |
| 24 | 315.0 | 83.5 |
| 25 | 400.0 | 88.0 |
| 26 | 500.0 | 80.9 |
| 27 | 630.0 | 84.5 |
| 28 | 800.0 | 81.8 |
| 29 | 1000.0 | 80.0 |
| 30 | 1250.0 | 80.2 |
| 31 | 1600.0 | 81.3 |
| 32 | 2000.0 | 80.6 |
| 33 | 2500.0 | 77.7 |
| 34 | 3150.0 | 78.4 |
| 35 | 4000.0 | 74.5 |
| 36 | 5000.0 | 74.7 |
| 37 | 6300.0 | 72.5 |
| 38 | 8000.0 | 70.3 |
| 39 | 10000.0 | 66.6 |
| 40 | 12500.0 | 62.8 |
| 41 | 16000.0 | 59.7 |
| 42 | 20000.0 | 56.0 |

A WEIGHTED LEVEL 91.8dB




Tape#12;Noise Levels

Loco#2534;Eng:N8,65mph;Aux Load=Full

Hotel Load=Full;78/08/26;1100hr

Mic Ht=4ft;Mic Pos=100Ft/Trk CL;Passby

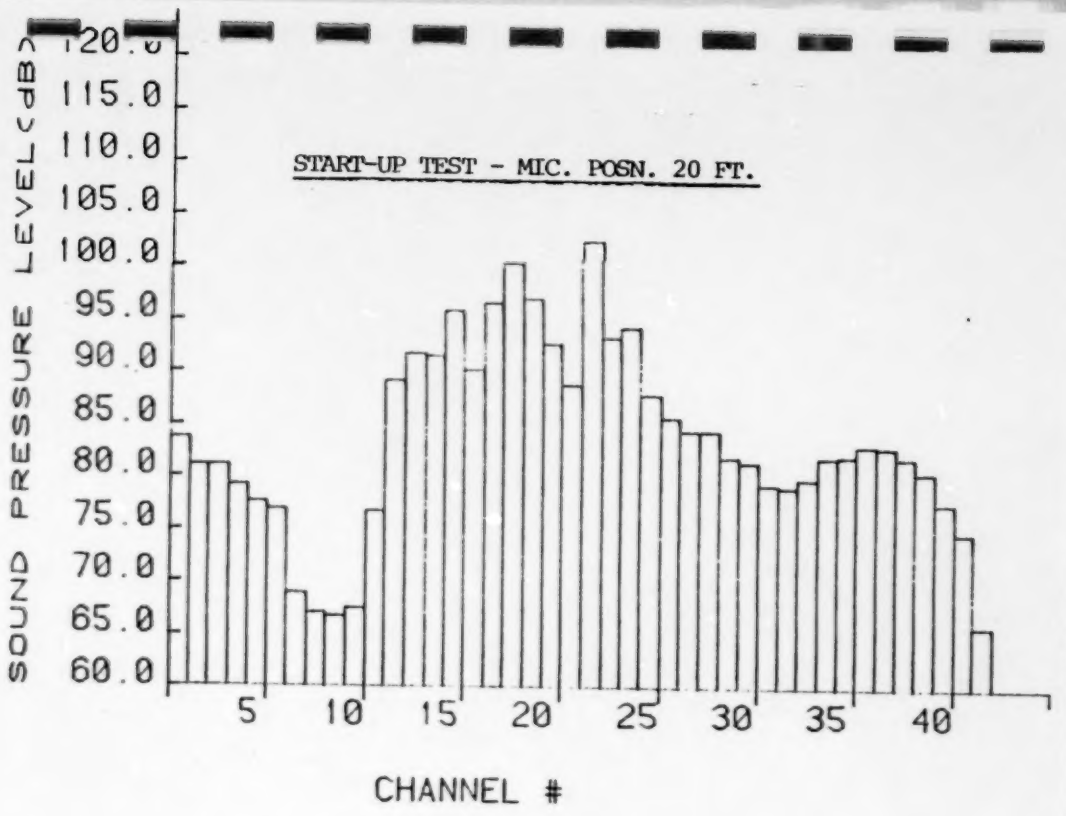
Att:2209=90,Nagra=40;Temp=22 C

Wind=600gt800 fpm from N.;Avg:Exp1/8,Max

FIG. 91

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 83.7 |
| 2 | 2.0 | 81.0 |
| 3 | 2.5 | 81.0 |
| 4 | 3.2 | 79.2 |
| 5 | 4.0 | 77.7 |
| 6 | 5.0 | 76.9 |
| 7 | 6.3 | 69.0 |
| 8 | 8.0 | 67.0 |
| 9 | 10.0 | 66.7 |
| 10 | 12.5 | 67.6 |
| 11 | 16.0 | 76.8 |
| 12 | 20.0 | 89.2 |
| 13 | 25.0 | 91.8 |
| 14 | 31.5 | 91.6 |
| 15 | 40.0 | 95.9 |
| 16 | 50.0 | 90.4 |
| 17 | 63.0 | 96.7 |
| 18 | 80.0 | 100.5 |
| 19 | 100.0 | 97.1 |
| 20 | 125.0 | 92.7 |
| 21 | 160.0 | 88.9 |
| 22 | 200.0 | 102.6 |
| 23 | 250.0 | 93.5 |
| 24 | 315.0 | 94.3 |
| 25 | 400.0 | 87.9 |
| 26 | 500.0 | 85.7 |
| 27 | 630.0 | 84.5 |
| 28 | 800.0 | 84.4 |
| 29 | 1000.0 | 82.0 |
| 30 | 1250.0 | 81.4 |
| 31 | 1600.0 | 79.4 |
| 32 | 2000.0 | 79.2 |
| 33 | 2500.0 | 79.9 |
| 34 | 3150.0 | 82.0 |
| 35 | 4000.0 | 82.2 |
| 36 | 5000.0 | 83.2 |
| 37 | 6300.0 | 83.1 |
| 38 | 8000.0 | 82.0 |
| 39 | 10000.0 | 80.5 |
| 40 | 12500.0 | 77.7 |
| 41 | 16000.0 | 74.8 |
| 42 | 20000.0 | 66.0 |

A WEIGHTED LEVEL 97.1dB




Tape#11;Noise Levels

Loco#2534;Eng:N8,Startup;Aux Load=Full

Hotel Load=Full;78/08/26;1100hr

Mic Pos=20Ft/Trk CL;Passby;Brakes

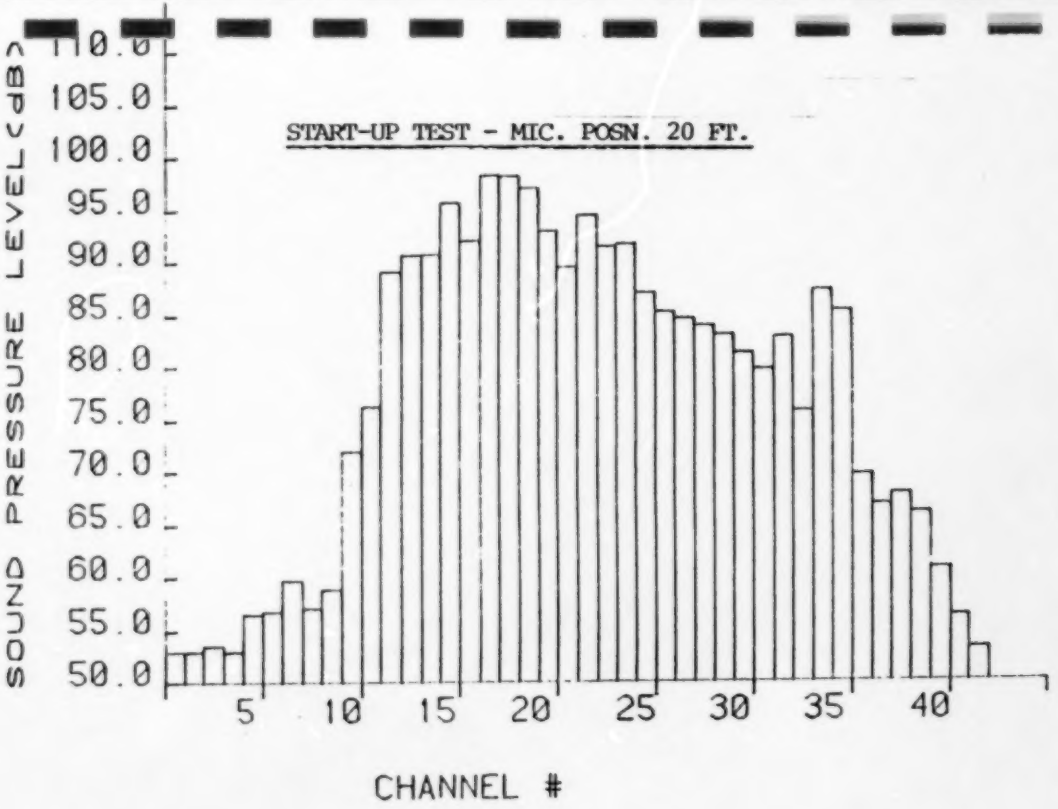
Att:2209=100,Nagra=40;Temp=22 C

Wind=600gt800 fpm from N.;Avg:Exp1/8,Max

FIG. 92

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 53.0 |
| 2 | 2.0 | 53.0 |
| 3 | 2.5 | 53.5 |
| 4 | 3.2 | 53.0 |
| 5 | 4.0 | 56.5 |
| 6 | 5.0 | 56.7 |
| 7 | 6.3 | 59.7 |
| 8 | 8.0 | 57.0 |
| 9 | 10.0 | 58.8 |
| 10 | 12.5 | 72.0 |
| 11 | 16.0 | 76.3 |
| 12 | 20.0 | 89.2 |
| 13 | 25.0 | 90.8 |
| 14 | 31.5 | 91.0 |
| 15 | 40.0 | 96.0 |
| 16 | 50.0 | 92.3 |
| 17 | 63.0 | 98.5 |
| 18 | 80.0 | 98.4 |
| 19 | 100.0 | 97.2 |
| 20 | 125.0 | 93.1 |
| 21 | 160.0 | 89.7 |
| 22 | 200.0 | 94.6 |
| 23 | 250.0 | 91.7 |
| 24 | 315.0 | 91.8 |
| 25 | 400.0 | 87.2 |
| 26 | 500.0 | 85.4 |
| 27 | 630.0 | 84.7 |
| 28 | 800.0 | 84.0 |
| 29 | 1000.0 | 83.2 |
| 30 | 1250.0 | 81.5 |
| 31 | 1600.0 | 79.9 |
| 32 | 2000.0 | 83.1 |
| 33 | 2500.0 | 75.9 |
| 34 | 3150.0 | 87.5 |
| 35 | 4000.0 | 85.5 |
| 36 | 5000.0 | 69.8 |
| 37 | 6300.0 | 67.0 |
| 38 | 8000.0 | 68.0 |
| 39 | 10000.0 | 66.1 |
| 40 | 12500.0 | 60.8 |
| 41 | 16000.0 | 56.2 |
| 42 | 20000.0 | 53.3 |

A WEIGHTED LEVEL 95.7dB




Tape#11;Noise Levels

Loco#2534;Eng:N8,Startup;Aux Load=Full

Hotel Load=Full;78/08/26;1100hr

Mic Pos=20Ft/Trk CL;Passby;Brakes

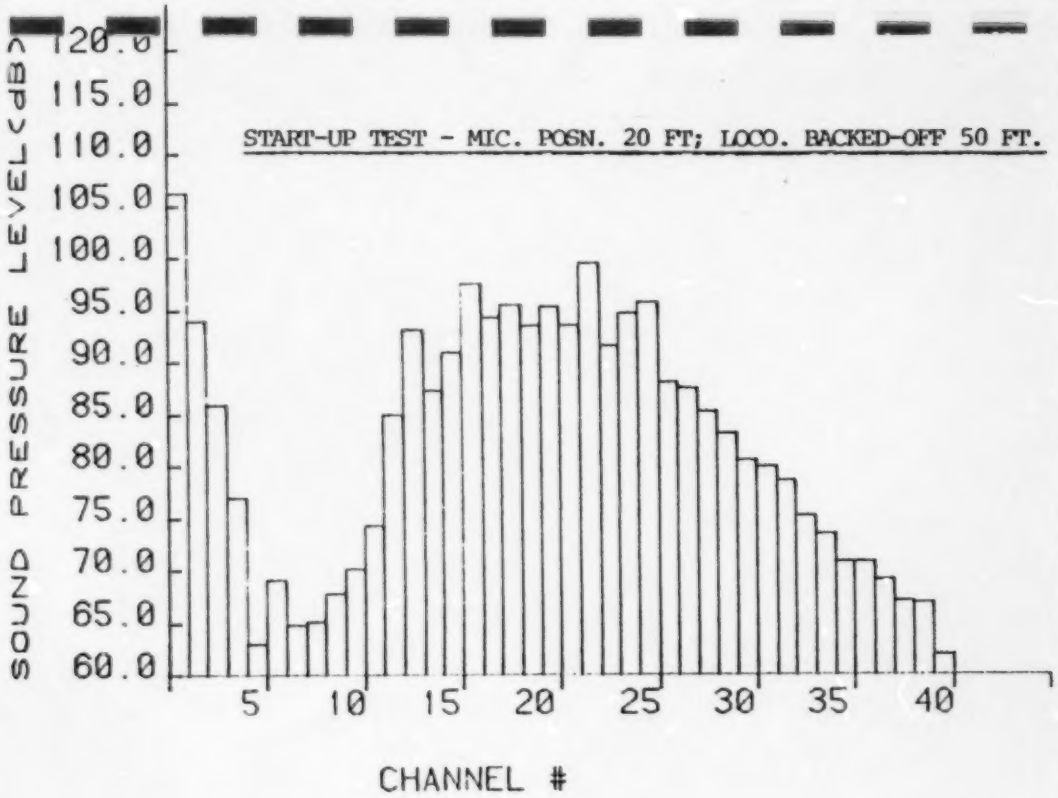
Att:2209=100,Nagra=40;Temp=22 C

Wind=600gt800 fpm from N.;Avg:Exp1/8,Max

FIG. 93

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 106.3 |
| 2 | 2.0 | 93.9 |
| 3 | 2.5 | 85.9 |
| 4 | 3.2 | 76.9 |
| 5 | 4.0 | 63.0 |
| 6 | 5.0 | 69.1 |
| 7 | 6.3 | 64.8 |
| 8 | 8.0 | 65.1 |
| 9 | 10.0 | 67.8 |
| 10 | 12.5 | 70.1 |
| 11 | 16.0 | 74.4 |
| 12 | 20.0 | 85.0 |
| 13 | 25.0 | 93.2 |
| 14 | 31.5 | 87.3 |
| 15 | 40.0 | 91.0 |
| 16 | 50.0 | 97.6 |
| 17 | 63.0 | 94.3 |
| 18 | 80.0 | 95.6 |
| 19 | 100.0 | 93.5 |
| 20 | 125.0 | 95.3 |
| 21 | 160.0 | 93.6 |
| 22 | 200.0 | 99.6 |
| 23 | 250.0 | 91.6 |
| 24 | 315.0 | 94.7 |
| 25 | 400.0 | 95.7 |
| 26 | 500.0 | 88.1 |
| 27 | 630.0 | 87.6 |
| 28 | 800.0 | 85.2 |
| 29 | 1000.0 | 83.2 |
| 30 | 1250.0 | 80.5 |
| 31 | 1600.0 | 80.0 |
| 32 | 2000.0 | 78.7 |
| 33 | 2500.0 | 75.2 |
| 34 | 3150.0 | 73.6 |
| 35 | 4000.0 | 70.9 |
| 36 | 5000.0 | 70.8 |
| 37 | 6300.0 | 69.2 |
| 38 | 8000.0 | 67.1 |
| 39 | 10000.0 | 66.9 |
| 40 | 12500.0 | 62.0 |
| 41 | 16000.0 | 59.5 |
| 42 | 20000.0 | 59.3 |

A WEIGHTED LEVEL 96.7dB




Tape#11;Noise Levels

Loco#2534;Eng:N8,Startup;Aux Load=Full

Hotel Load=Full;78/08/26;1100hr

Mic Pos=20Ft/Trk CL;Passby

Att:2209=100,Nagra=40;Temp=22 C

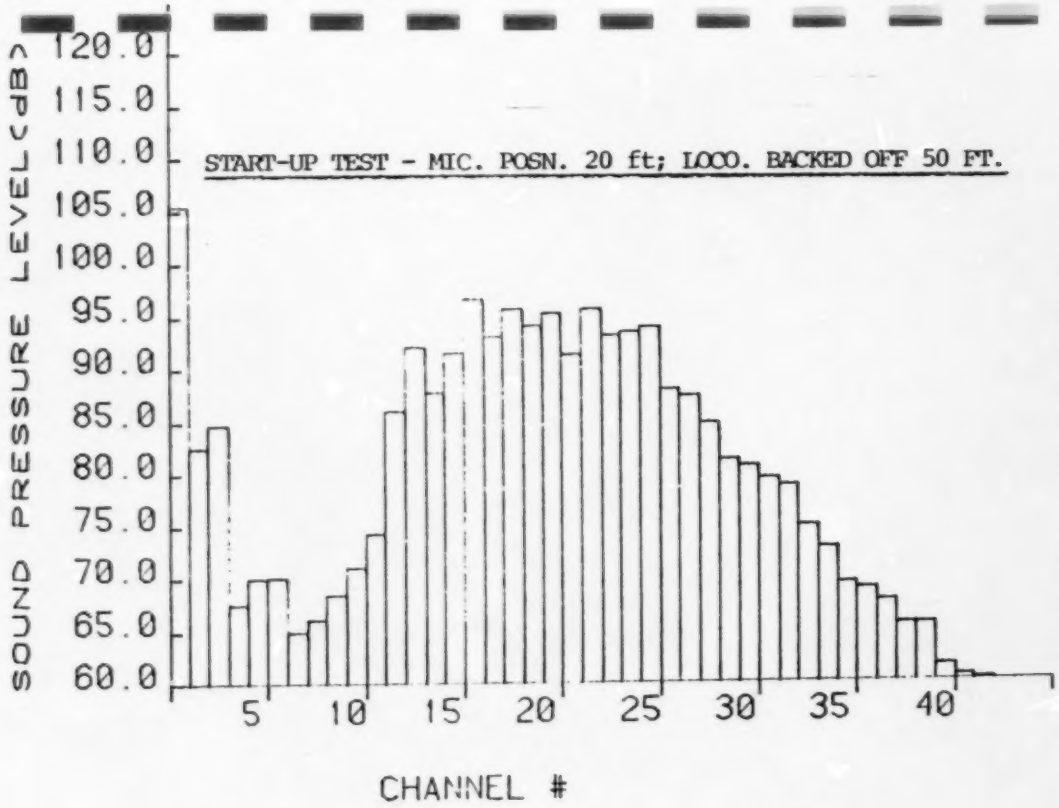
Wind=600gt800 fpm from N.;Avg:Exp1/8,Max



FIG. 94

| CH.#. | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 105.5 |
| 2 | 2.0 | 82.5 |
| 3 | 2.5 | 84.7 |
| 4 | 3.2 | 67.5 |
| 5 | 4.0 | 70.0 |
| 6 | 5.0 | 70.1 |
| 7 | 6.3 | 65.0 |
| 8 | 8.0 | 66.1 |
| 9 | 10.0 | 68.4 |
| 10 | 12.5 | 71.1 |
| 11 | 16.0 | 74.4 |
| 12 | 20.0 | 86.0 |
| 13 | 25.0 | 92.1 |
| 14 | 31.5 | 87.8 |
| 15 | 40.0 | 91.7 |
| 16 | 50.0 | 96.7 |
| 17 | 63.0 | 93.2 |
| 18 | 80.0 | 95.8 |
| 19 | 100.0 | 94.2 |
| 20 | 125.0 | 95.4 |
| 21 | 160.0 | 91.4 |
| 22 | 200.0 | 95.8 |
| 23 | 250.0 | 93.3 |
| 24 | 315.0 | 93.6 |
| 25 | 400.0 | 94.1 |
| 26 | 500.0 | 88.1 |
| 27 | 630.0 | 87.4 |
| 28 | 800.0 | 84.8 |
| 29 | 1000.0 | 81.4 |
| 30 | 1250.0 | 80.7 |
| 31 | 1600.0 | 79.5 |
| 32 | 2000.0 | 78.9 |
| 33 | 2500.0 | 75.0 |
| 34 | 3150.0 | 72.9 |
| 35 | 4000.0 | 69.6 |
| 36 | 5000.0 | 69.0 |
| 37 | 6300.0 | 87.9 |
| 38 | 8000.0 | 65.7 |
| 39 | 10000.0 | 65.6 |
| 40 | 12500.0 | 61.6 |
| 41 | 16000.0 | 60.5 |
| 42 | 20000.0 | 60.3 |

A WEIGHTED LEVEL 95.6dB




Tape#11;Noise Levels

Loco#2534;Eng:N8,Startup;Aux Load=Full

Hotel Load=Full;78/08/26;1100hr

Mic Pos=20Ft/Trk CL;Passby

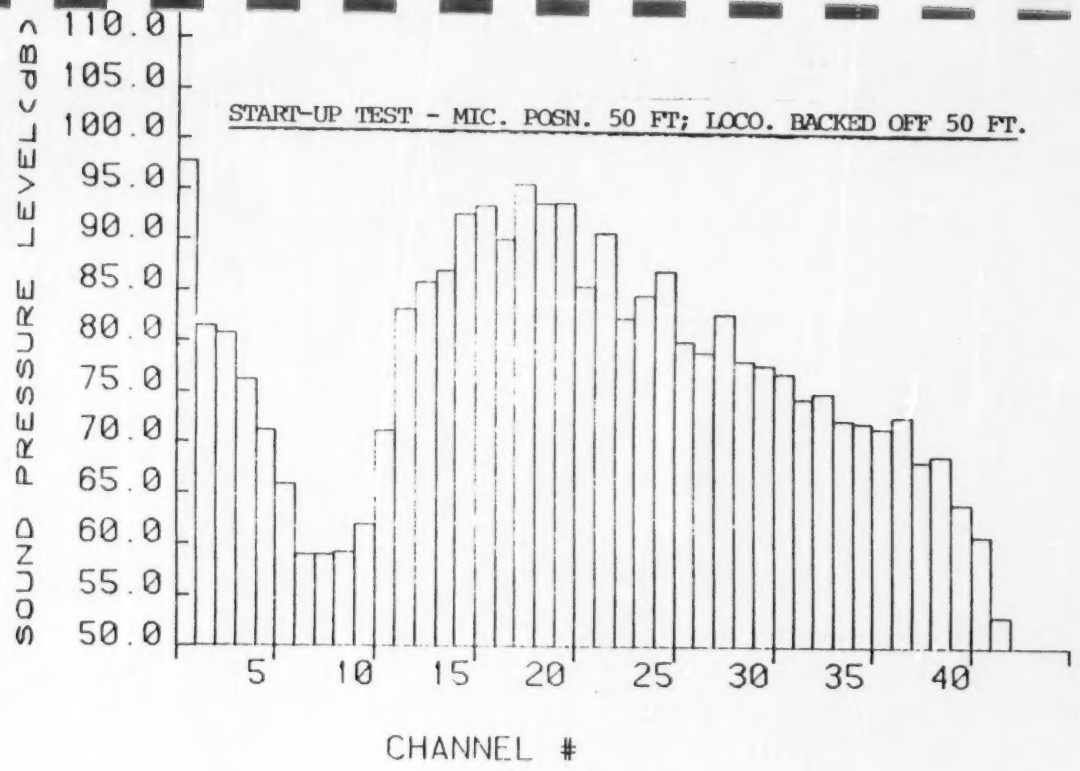
Att:2209=100,Nagra=41;Temp=22 C

Wind=600gt800 fpm from N.;Avg:Exp1/8,Max

FIG. 95

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 97.7 |
| 2 | 2.0 | 81.5 |
| 3 | 2.5 | 80.7 |
| 4 | 3.2 | 76.1 |
| 5 | 4.0 | 71.2 |
| 6 | 5.0 | 65.9 |
| 7 | 6.3 | 59.0 |
| 8 | 8.0 | 59.0 |
| 9 | 10.0 | 59.2 |
| 10 | 12.5 | 61.9 |
| 11 | 16.0 | 71.3 |
| 12 | 20.0 | 83.1 |
| 13 | 25.0 | 85.8 |
| 14 | 31.5 | 86.9 |
| 15 | 40.0 | 92.5 |
| 16 | 50.0 | 93.3 |
| 17 | 63.0 | 90.1 |
| 18 | 80.0 | 95.5 |
| 19 | 100.0 | 93.5 |
| 20 | 125.0 | 93.7 |
| 21 | 160.0 | 85.3 |
| 22 | 200.0 | 90.7 |
| 23 | 250.0 | 82.3 |
| 24 | 315.0 | 84.4 |
| 25 | 400.0 | 86.9 |
| 26 | 500.0 | 79.9 |
| 27 | 630.0 | 78.8 |
| 28 | 800.0 | 82.6 |
| 29 | 1000.0 | 78.0 |
| 30 | 1250.0 | 77.5 |
| 31 | 1600.0 | 76.8 |
| 32 | 2000.0 | 74.3 |
| 33 | 2500.0 | 74.8 |
| 34 | 3150.0 | 72.3 |
| 35 | 4000.0 | 72.0 |
| 36 | 5000.0 | 71.5 |
| 37 | 6300.0 | 72.5 |
| 38 | 8000.0 | 68.2 |
| 39 | 10000.0 | 68.7 |
| 40 | 12500.0 | 64.1 |
| 41 | 16000.0 | 60.9 |
| 42 | 20000.0 | 53.1 |

A WEIGHTED LEVEL 90.3dB




Tape#11;Noise Levels

Loco#2534;Eng:N8,Startup;Aux Load=Full

Hotel Load=Full;78/08/26;1100hr

Mic Ht=4ft;Mic Pos=50 Ft/Trk CL;Passby

Att:2209=90,Nagra=42;Temp=22 C

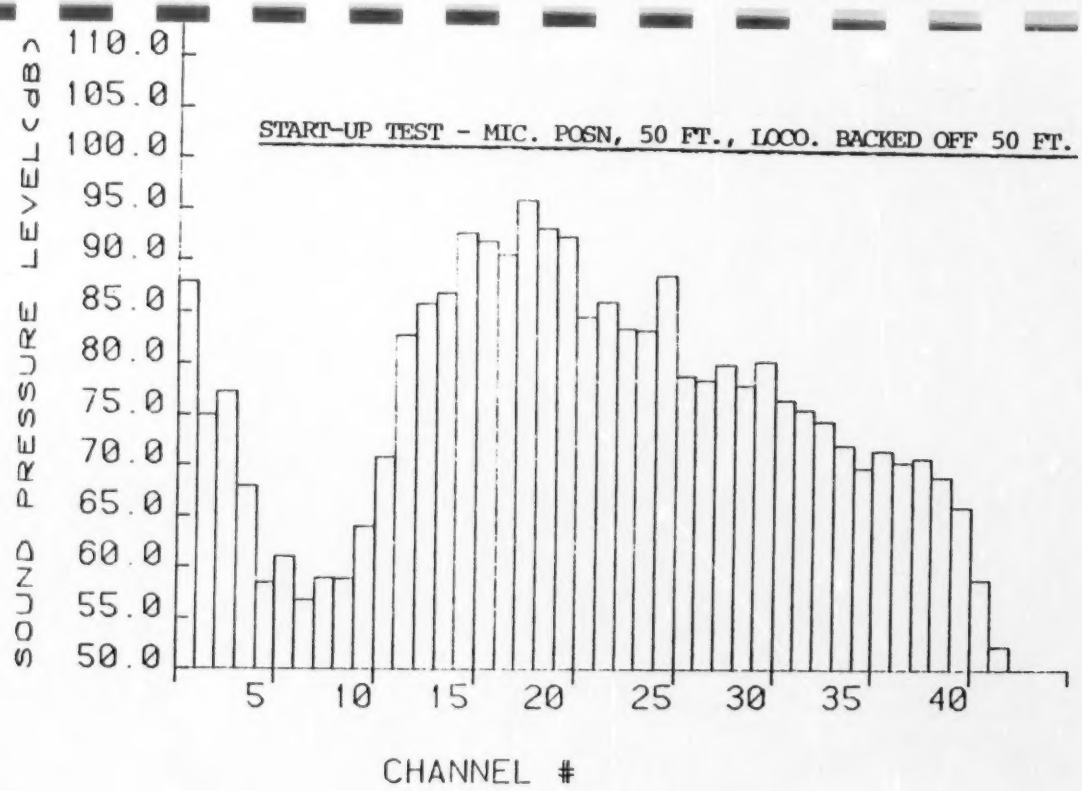
Wind=600gt800 fpm from N.;Avg:Exp1/8,Max



FIG. 96

| CH. # | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 87.8 |
| 2 | 2.0 | 74.9 |
| 3 | 2.5 | 77.2 |
| 4 | 3.2 | 68.0 |
| 5 | 4.0 | 58.5 |
| 6 | 5.0 | 61.0 |
| 7 | 6.3 | 56.8 |
| 8 | 8.0 | 59.0 |
| 9 | 10.0 | 58.9 |
| 10 | 12.5 | 64.0 |
| 11 | 16.0 | 70.8 |
| 12 | 20.0 | 82.7 |
| 13 | 25.0 | 85.8 |
| 14 | 31.5 | 86.8 |
| 15 | 40.0 | 92.7 |
| 16 | 50.0 | 91.9 |
| 17 | 63.0 | 90.6 |
| 18 | 80.0 | 96.0 |
| 19 | 100.0 | 93.2 |
| 20 | 125.0 | 92.4 |
| 21 | 160.0 | 84.6 |
| 22 | 200.0 | 86.0 |
| 23 | 250.0 | 83.4 |
| 24 | 315.0 | 83.3 |
| 25 | 400.0 | 88.6 |
| 26 | 500.0 | 78.9 |
| 27 | 630.0 | 78.5 |
| 28 | 800.0 | 80.0 |
| 29 | 1000.0 | 78.0 |
| 30 | 1250.0 | 80.3 |
| 31 | 1600.0 | 76.6 |
| 32 | 2000.0 | 75.7 |
| 33 | 2500.0 | 74.5 |
| 34 | 3150.0 | 72.1 |
| 35 | 4000.0 | 70.0 |
| 36 | 5000.0 | 71.6 |
| 37 | 6300.0 | 70.4 |
| 38 | 8000.0 | 70.8 |
| 39 | 10000.0 | 69.0 |
| 40 | 12500.0 | 66.0 |
| 41 | 16000.0 | 58.9 |
| 42 | 20000.0 | 52.3 |

A WEIGHTED LEVEL 90.1dB




Tape#11;Noise Levels

Loco#2534;Eng:N8,Startup;Aux Load=Full

Hotel Load=Full;78/08/26;1100hr

Mic Ht=4ft;Mic Pos 50 Ft./Trk CL;Passby

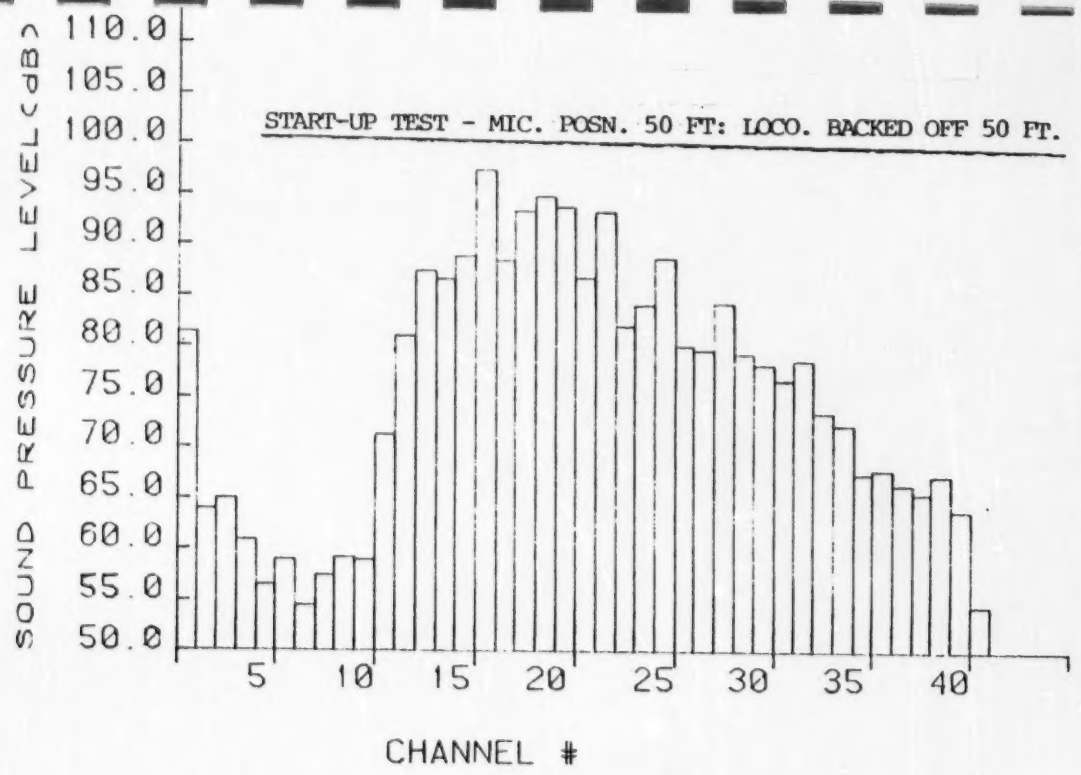
Att:2209=90,Nagra=42;Temp=22 C

Wind=600gt800 fpm from N.;Avg:Exp1/8,Max

FIG. 97

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 81.3 |
| 2 | 2.0 | 63.9 |
| 3 | 2.5 | 65.0 |
| 4 | 3.2 | 60.9 |
| 5 | 4.0 | 56.5 |
| 6 | 5.0 | 59.0 |
| 7 | 6.3 | 54.4 |
| 8 | 8.0 | 57.4 |
| 9 | 10.0 | 59.2 |
| 10 | 12.5 | 59.0 |
| 11 | 16.0 | 71.4 |
| 12 | 20.0 | 81.1 |
| 13 | 25.0 | 87.5 |
| 14 | 31.5 | 86.7 |
| 15 | 40.0 | 88.9 |
| 16 | 50.0 | 97.5 |
| 17 | 63.0 | 88.5 |
| 18 | 80.0 | 93.5 |
| 19 | 100.0 | 94.9 |
| 20 | 125.0 | 93.8 |
| 21 | 160.0 | 86.8 |
| 22 | 200.0 | 93.3 |
| 23 | 250.0 | 82.1 |
| 24 | 315.0 | 84.2 |
| 25 | 400.0 | 88.8 |
| 26 | 500.0 | 80.1 |
| 27 | 630.0 | 79.8 |
| 28 | 800.0 | 84.3 |
| 29 | 1000.0 | 79.4 |
| 30 | 1250.0 | 78.4 |
| 31 | 1600.0 | 76.8 |
| 32 | 2000.0 | 78.8 |
| 33 | 2500.0 | 73.5 |
| 34 | 3150.0 | 72.4 |
| 35 | 4000.0 | 67.6 |
| 36 | 5000.0 | 68.0 |
| 37 | 6300.0 | 66.5 |
| 38 | 8000.0 | 65.7 |
| 39 | 10000.0 | 67.4 |
| 40 | 12500.0 | 64.0 |
| 41 | 16000.0 | 54.6 |
| 42 | 20000.0 | 49.3 |

A WEIGHTED LEVEL 91.4dB




Tape#11;Noise Levels

Loco#2534;Eng:N8,Startup;Aux Load=Full

Hotel Load=Full;78/08/26;1100hr

Mic Ht=4ft;Mic Pos:50 Ft./Trk CL;Passby

Att:2209=90,Nagra=40;Temp=22 C

Wind=600gt800 fpm from N.;Avg:Exp1/8,Max



FIG. 98

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 76.7 |
| 2 | 2.0 | 53.0 |
| 3 | 2.5 | 53.5 |
| 4 | 3.2 | 56.5 |
| 5 | 4.0 | 59.0 |
| 6 | 5.0 | 59.1 |
| 7 | 6.3 | 57.9 |
| 8 | 8.0 | 59.3 |
| 9 | 10.0 | 63.3 |
| 10 | 12.5 | 65.7 |
| 11 | 16.0 | 68.6 |
| 12 | 20.0 | 79.1 |
| 13 | 25.0 | 84.4 |
| 14 | 31.5 | 85.2 |
| 15 | 40.0 | 89.3 |
| 16 | 50.0 | 90.6 |
| 17 | 63.0 | 86.6 |
| 18 | 80.0 | 90.4 |
| 19 | 100.0 | 89.2 |
| 20 | 125.0 | 86.9 |
| 21 | 160.0 | 80.2 |
| 22 | 200.0 | 75.5 |
| 23 | 250.0 | 77.2 |
| 24 | 315.0 | 76.8 |
| 25 | 400.0 | 83.9 |
| 26 | 500.0 | 74.6 |
| 27 | 630.0 | 76.4 |
| 28 | 800.0 | 75.8 |
| 29 | 1000.0 | 74.1 |
| 30 | 1250.0 | 74.2 |
| 31 | 1600.0 | 74.8 |
| 32 | 2000.0 | 72.6 |
| 33 | 2500.0 | 71.6 |
| 34 | 3150.0 | 68.6 |
| 35 | 4000.0 | 64.9 |
| 36 | 5000.0 | 67.1 |
| 37 | 6300.0 | 67.8 |
| 38 | 8000.0 | 65.9 |
| 39 | 10000.0 | 63.8 |
| 40 | 12500.0 | 57.0 |
| 41 | 16000.0 | 51.3 |
| 42 | 20000.0 | 49.3 |

A WEIGHTED LEVEL 85.8dB

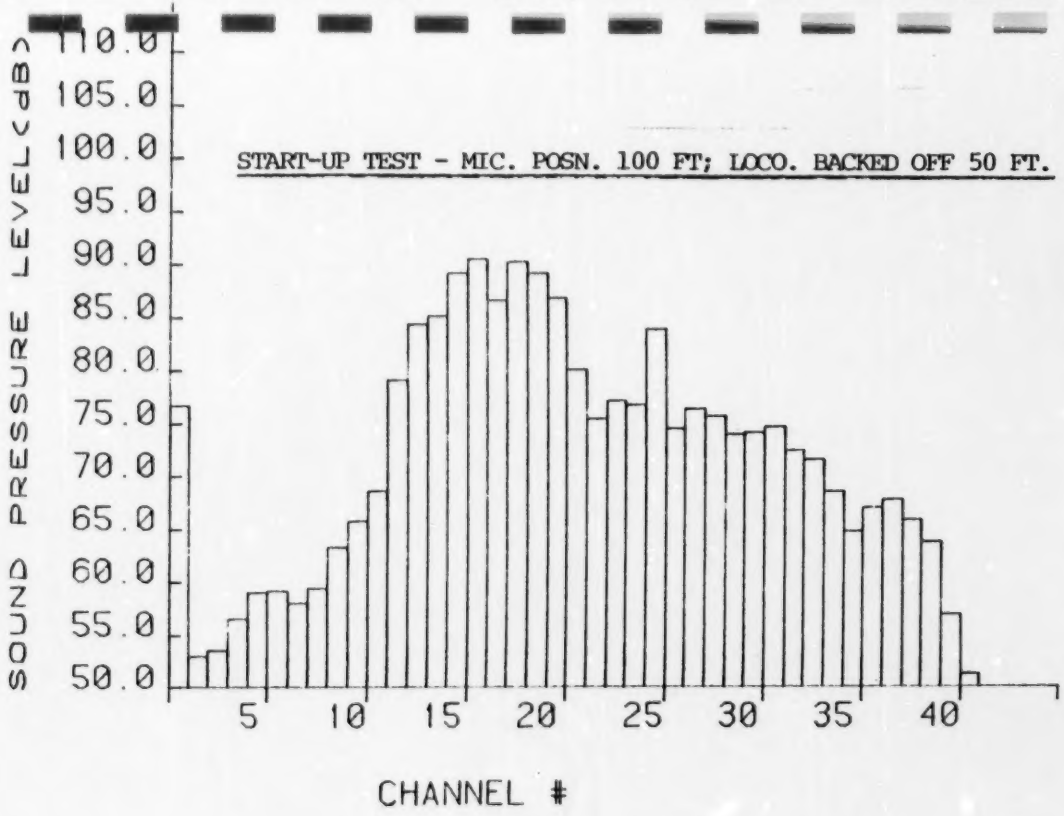
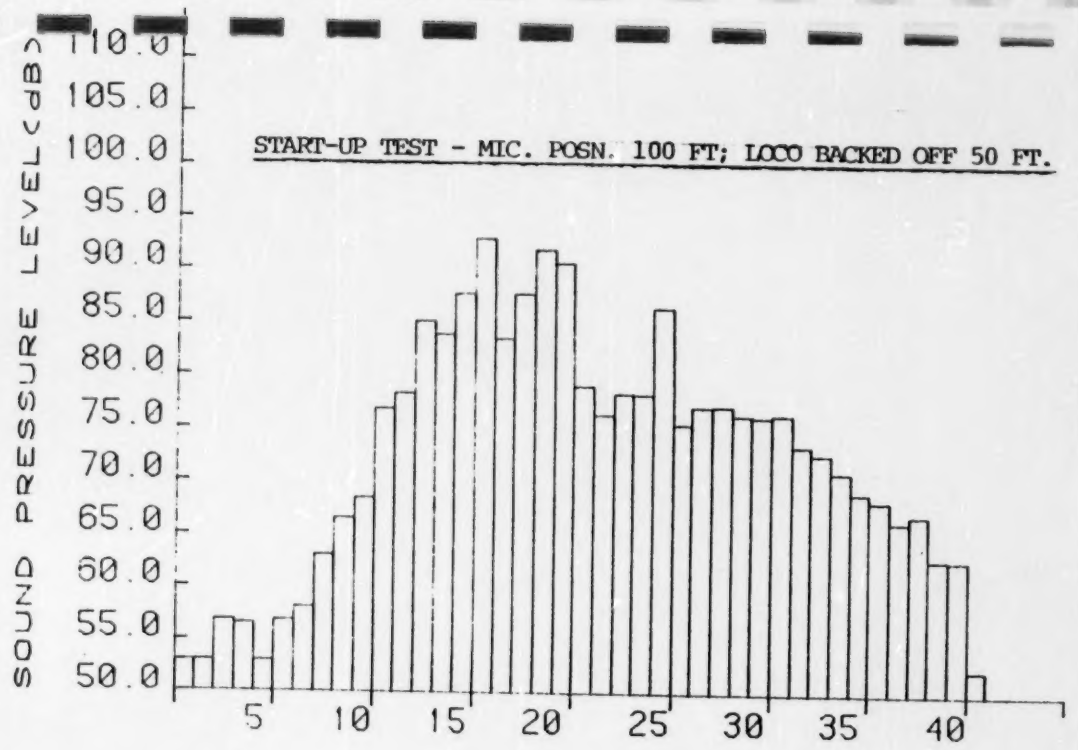





FIG. 99

| CH.# | FREQ(Hz) | LEVEL(dB) |
|---|---|---|
| 1 | 1.6 | 53.0 |
| 2 | 2.0 | 53.0 |
| 3 | 2.5 | 56.7 |
| 4 | 3.2 | 56.5 |
| 5 | 4.0 | 53.0 |
| 6 | 5.0 | 56.7 |
| 7 | 6.3 | 58.1 |
| 8 | 8.0 | 63.0 |
| 9 | 10.0 | 66.5 |
| 10 | 12.5 | 68.4 |
| 11 | 16.0 | 76.9 |
| 12 | 20.0 | 78.3 |
| 13 | 25.0 | 85.2 |
| 14 | 31.5 | 83.9 |
| 15 | 40.0 | 87.9 |
| 16 | 50.0 | 93.1 |
| 17 | 63.0 | 83.6 |
| 18 | 80.0 | 87.9 |
| 19 | 100.0 | 92.0 |
| 20 | 125.0 | 90.8 |
| 21 | 160.0 | 79.1 |
| 22 | 200.0 | 76.5 |
| 23 | 250.0 | 78.5 |
| 24 | 315.0 | 78.3 |
| 25 | 400.0 | 86.5 |
| 26 | 500.0 | 75.6 |
| 27 | 630.0 | 77.2 |
| 28 | 800.0 | 77.3 |
| 29 | 1000.0 | 76.5 |
| 30 | 1250.0 | 76.2 |
| 31 | 1600.0 | 76.6 |
| 32 | 2000.0 | 73.6 |
| 33 | 2500.0 | 72.8 |
| 34 | 3150.0 | 71.1 |
| 35 | 4000.0 | 69.2 |
| 36 | 5000.0 | 68.4 |
| 37 | 6300.0 | 66.4 |
| 38 | 8000.0 | 67.1 |
| 39 | 10000.0 | 62.9 |
| 40 | 12500.0 | 62.8 |
| 41 | 16000.0 | 52.5 |
| 42 | 20000.0 | 49.3 |

A WEIGHTED LEVEL 87.6dB




Tape#11;Noise Levels

Loco#2534;Eng:N8,Startup;Aux Load=Full

Hotel Load=Full;78/08/26;1100hr

Mic Ht=4ft;Mic Pos:100Ft/Trk CL;Passby

Att:2209=90,Nagra=40;Temp=22 C

Wind=600gt800 fpm from N.;Avg:Exp1/8,Max

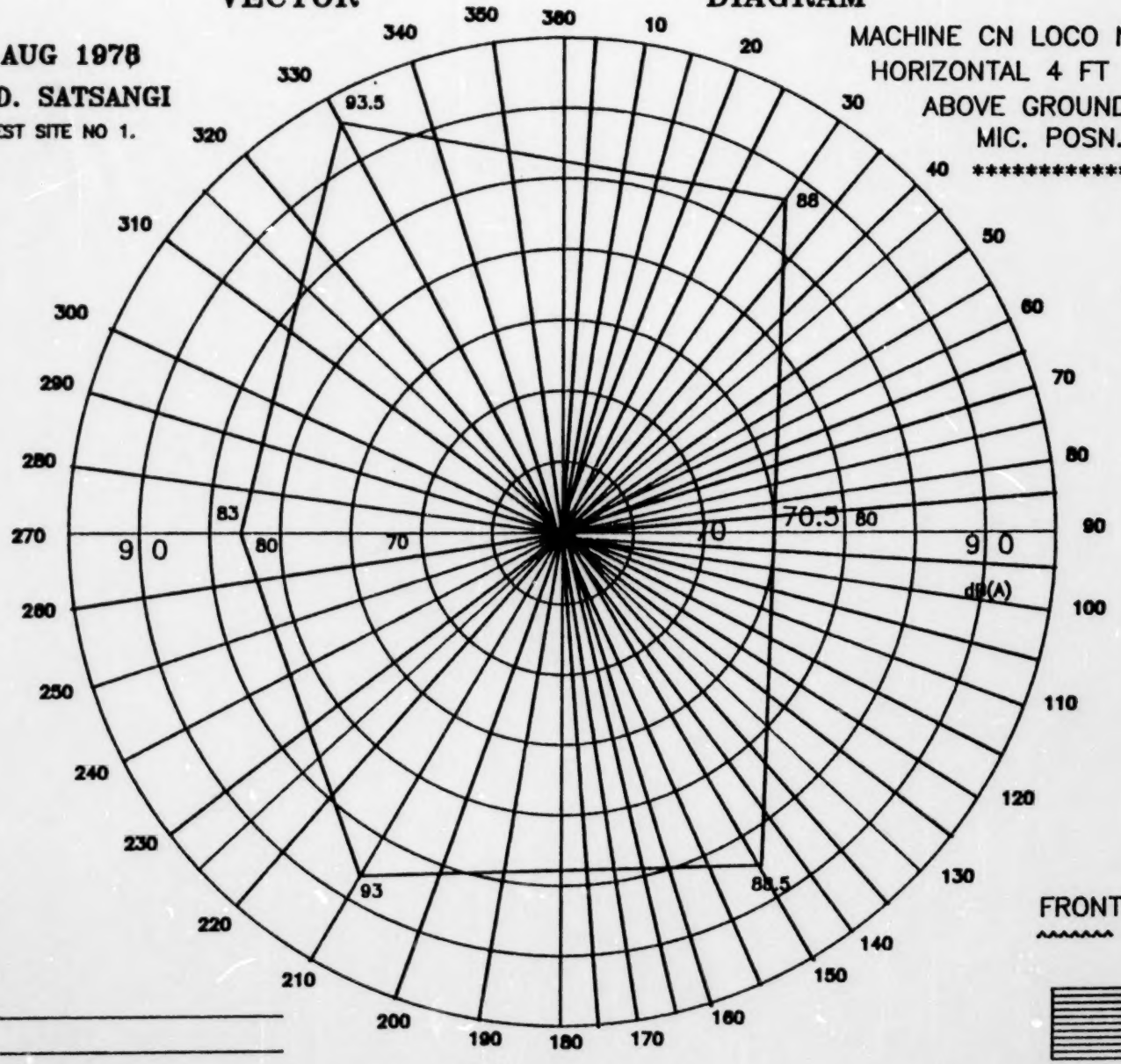


FIG. 100

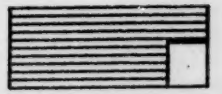
# VECTOR DIAGRAM

DATE 20 AUG 1978
OPERAT. D. SATSANGI
LOCAT. MLW TEST SITE NO 1.

MACHINE CN LOCO NO: 2534
HORIZONTAL 4 FT
ABOVE GROUND
MIC. POSN. 20 FT.
******************




FRONT



RESULTS _____

_____

_____

FIG. 101

# COMPARISON OF THE BASELINE NOISE LEVELS WITH THE TARGET NOISE LEVELS

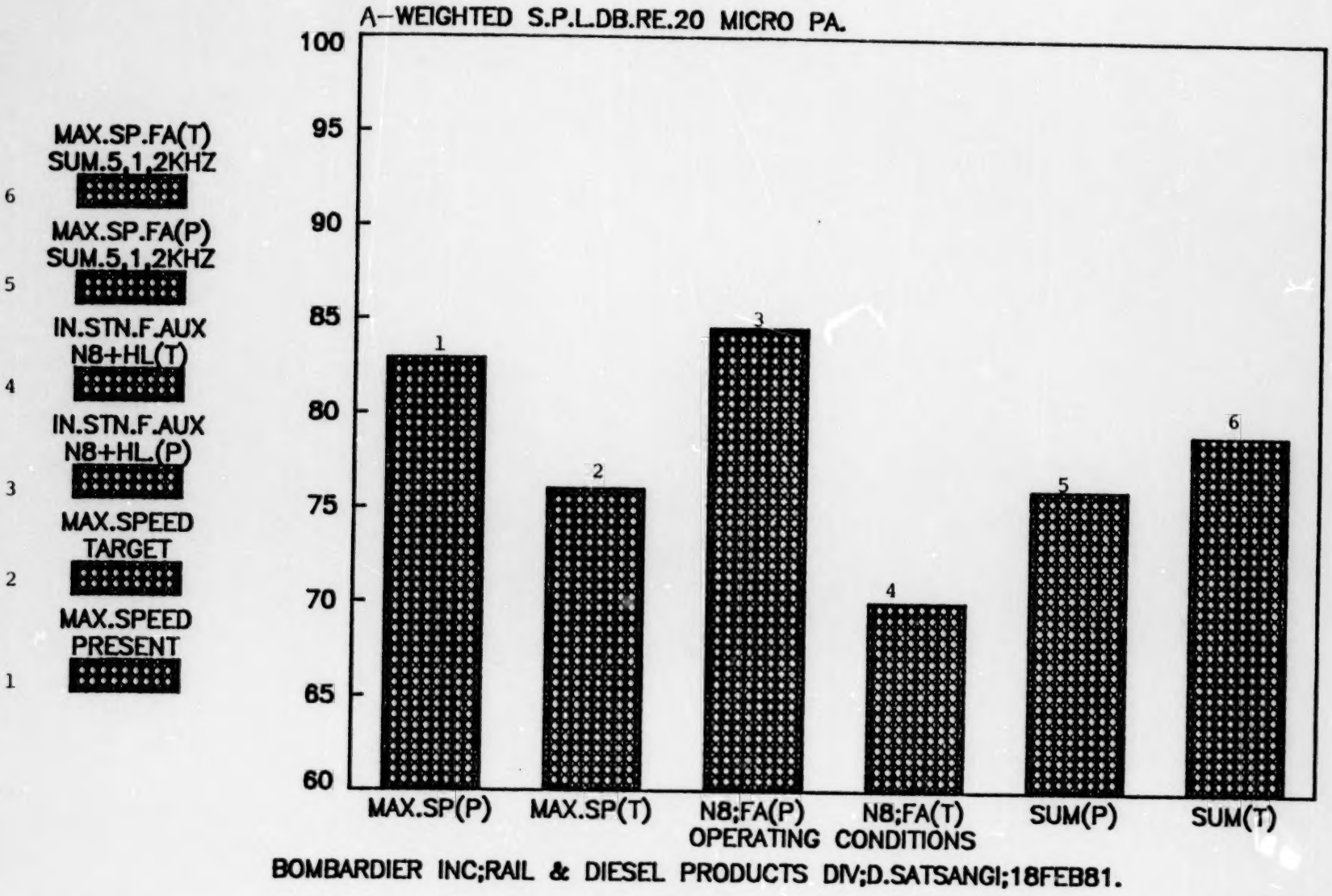



FIG. 102

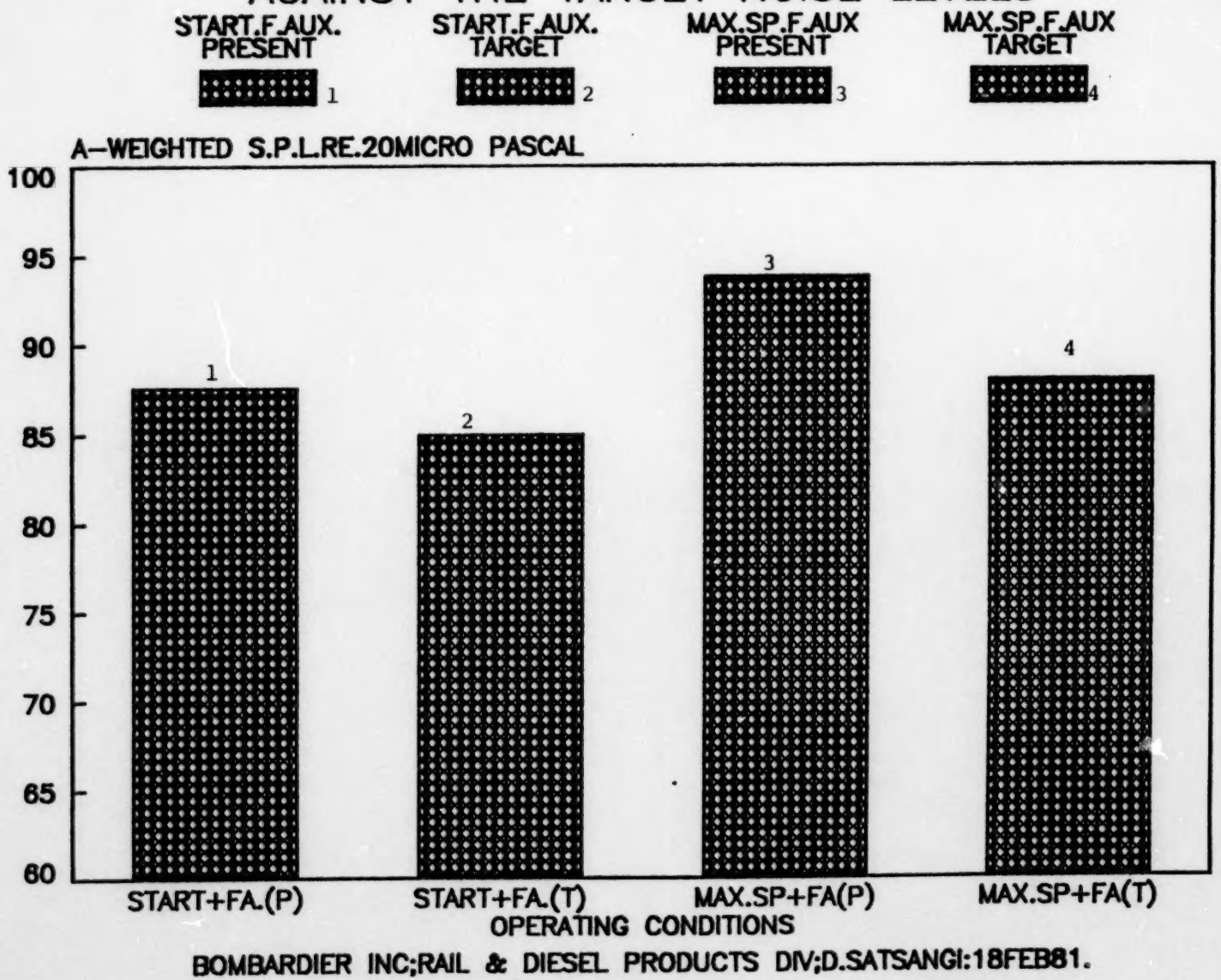

COMPARISON OF THE BASELINE NOISE LEVELS
AGAINST THE TARGET NOISE LEVELS
START.F.AUX. PRESENT
1
START.F.AUX. TARGET
2
MAX.SP.F.AUX PRESENT
3
MAX.SP.F.AUX TARGET
4
A-WEIGHTED S.P.L.RE.20MICRO PASCAL
100
95
90
85
80
75
70
65
60
START+FA.(P)
START+FA.(T)
MAX.SP+FA(P)
MAX.SP+FA(T)
OPERATING CONDITIONS
BOMBARDIER INC;RAIL & DIESEL PRODUCTS DIV;D.SATSANGI:18FEB81.

FIG. 103

# COMPARISON OF THE BASELINE NOISE LEVELS AGAINST THE TARGET NOISE LEVELS

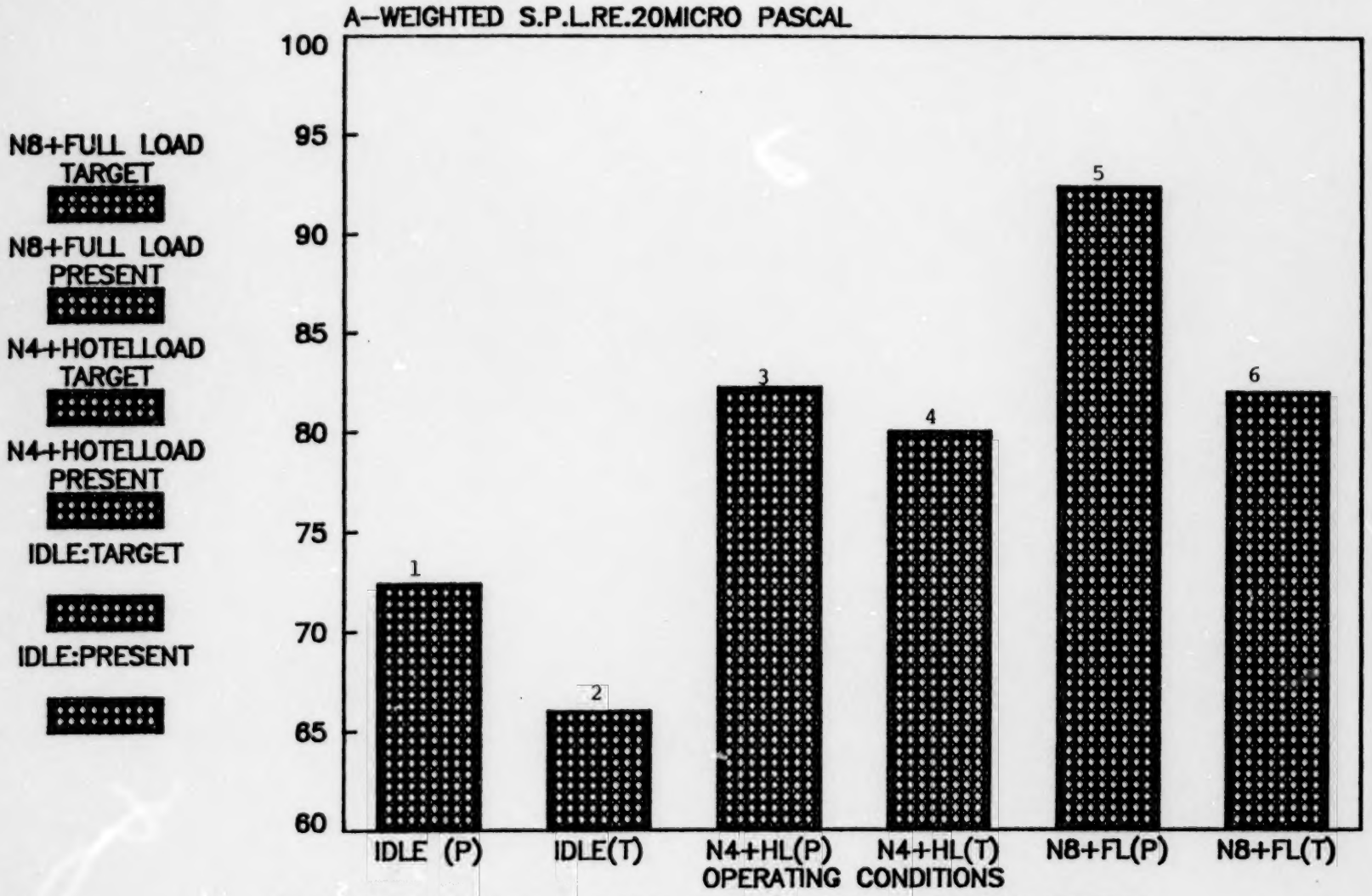
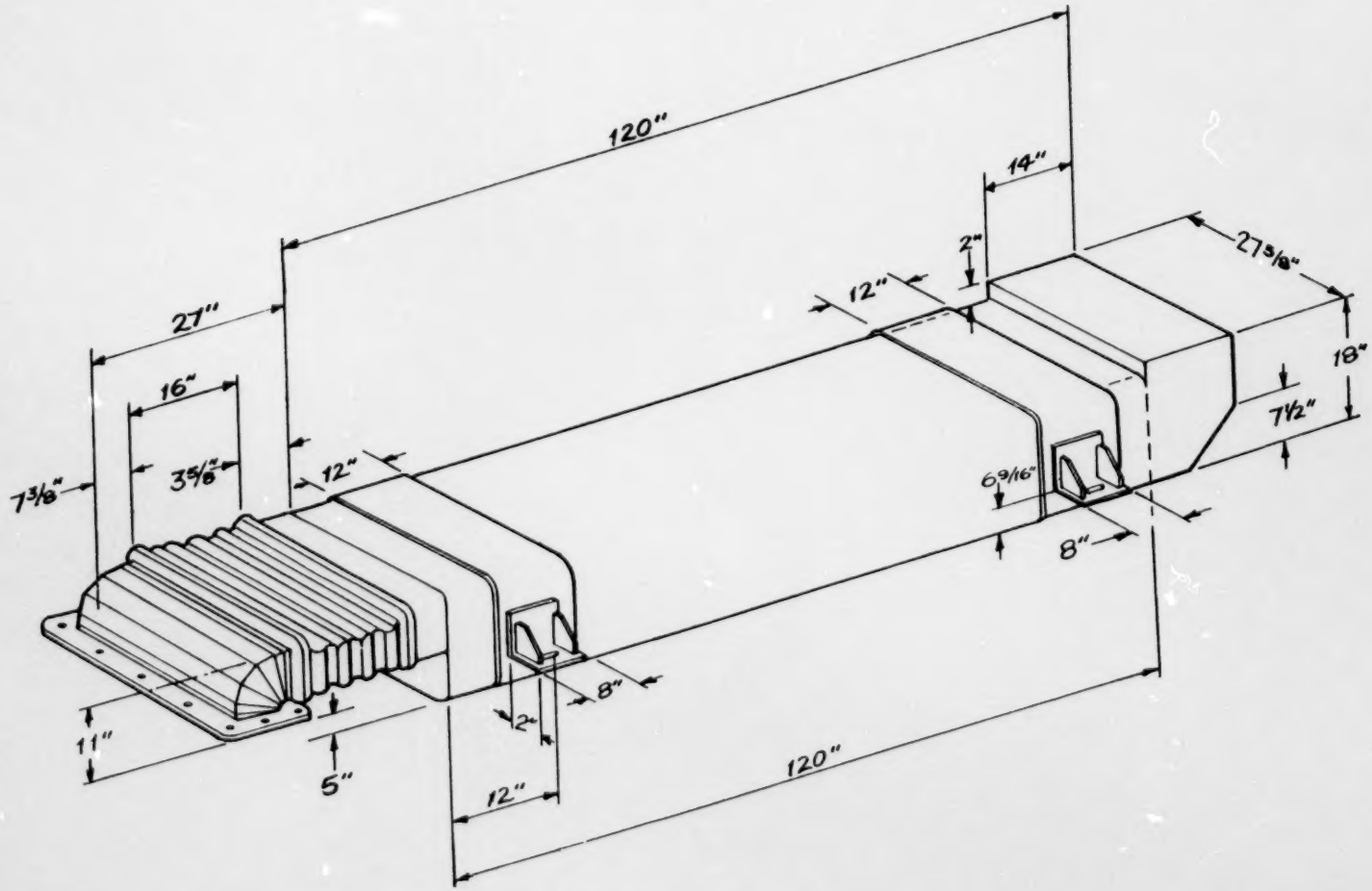



FIG. 104




EXHAUST SILENCER LAYOUT DRAWING

FIG. 105

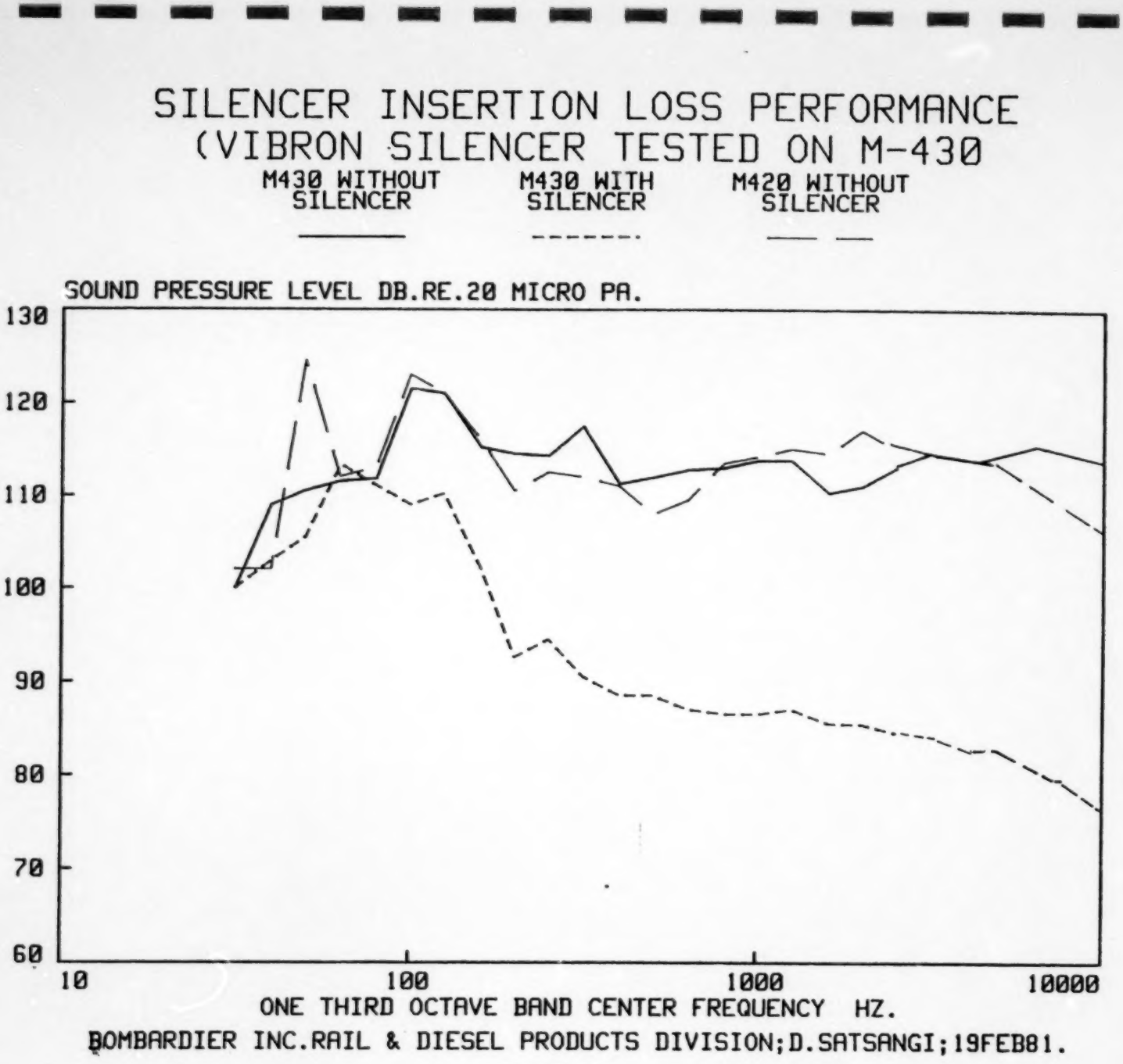

SILENCER INSERTION LOSS PERFORMANCE
(VIBRON SILENCER TESTED ON M-430
M430 WITHOUT SILENCER
M430 WITH SILENCER
M420 WITHOUT SILENCER
SOUND PRESSURE LEVEL DB.RE.20 MICRO PA.
130
120
110
100
90
80
70
60
10
100
1000
10000
ONE THIRD OCTAVE BAND CENTER FREQUENCY HZ.
BOMBARDIER INC.RAIL & DIESEL PRODUCTS DIVISION;D.SATSANGI;19FEB81.

FIG. 106

# IMPROVEMENT IN CAB NOISE LEVELS ON BOMBARDIER LOCOMOTIVES OVER THE YEARS

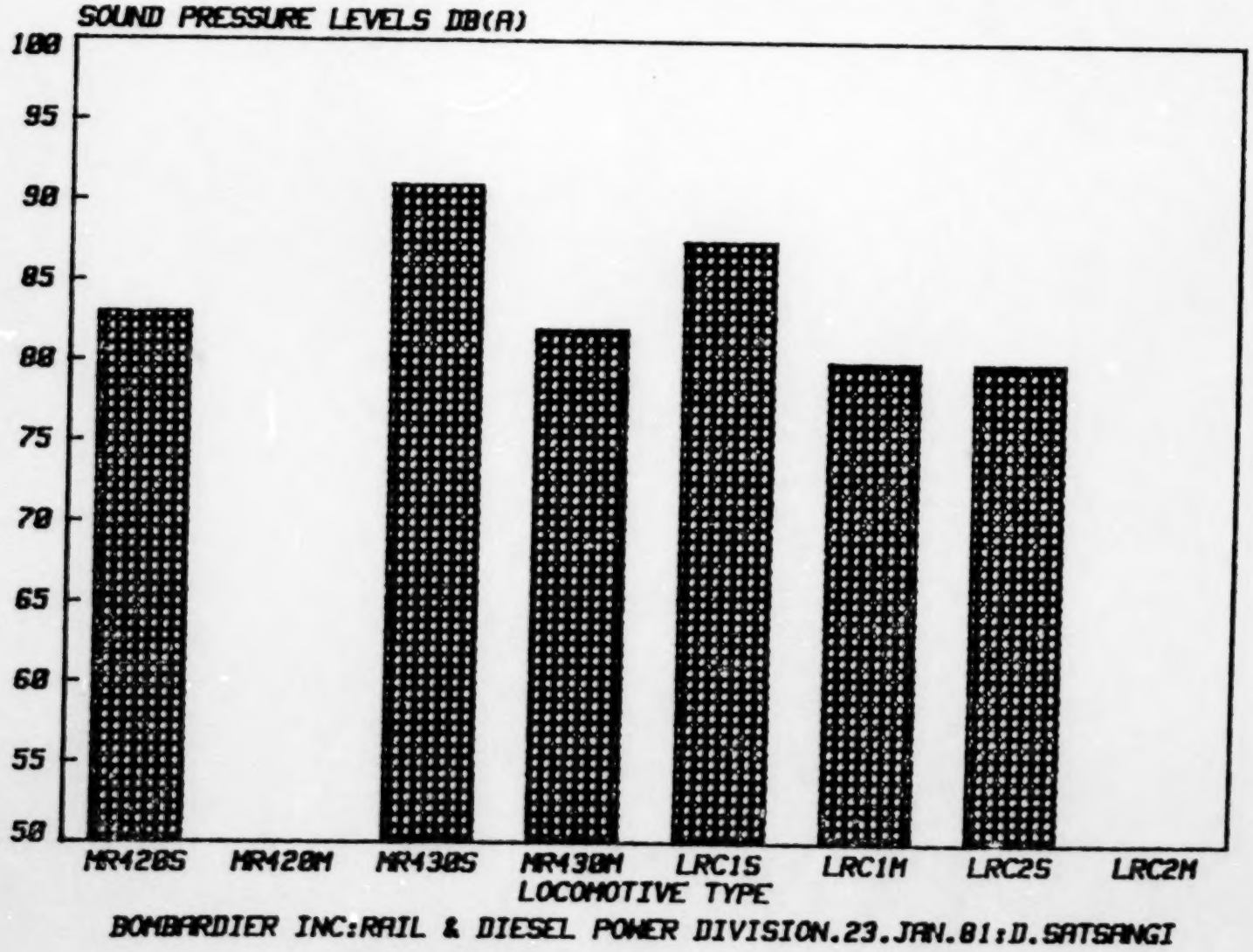



FIG. 107

TABLE

SUMMARY OF THE SOURCE NOISE LEVELS

| Noise Source | Sound Pressure Level (dBA) | Microphone Location (Ft.) |
|---|---|---|
| Engine Exhaust | 126.5 | 3 |
| Radiator fan (outside fan compartment) | 106.5 | 3 |
| Radiator fan (inside fan compartment) | 115.5 | 1 |
| Dynamic brake blower | 111.5 | 3 |
| Primary air intake | 105.5 | 3 |
| Traction motor blower (aux. equipment compartment (A.E.C) door open) | 105 | 3 |
| Traction motor blower (A.E.C. door closed) | 96 | 3 |
| Turbocharger | 112.5 | 1 |
| Air compressor | 101.6 | 3 |